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REPORTS OF THE SWEDISH DEEP-SEA EXPEDITION. VOL. VIII
SEDIMENT CORES FROM THE MEDITERRANEAN SEA AND THE RED SEA. NO. 4

EASTERN MEDITERRANEAN FORAMINIFERA

BY

FRANCES L. PARKER

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Table of Contents

Page

Summary 219

Introduction 221

Location of Cores and Surface Sediment Samples 221

Methods of Study 223

Foraminifera in Surface Sediment Samples 224

- Temperature and Salinity 224
- Planktonic Foraminifera 225
  - General Statement 225
  - Discussion 226
- Benthonic Foraminifera 227
  - General Statement 227
  - Depth Distribution 227
  - Non-depositional Areas 232
  - Displaced Faunas 232

Foraminifera in Cores 233

- Benthonic Foraminifera 233
- Planktonic Foraminifera 234
- Discussion 238

Appendix A: Core Descriptions 242

Appendix B: Systematic Descriptions 252

References 281

Tables 285

Summary

1. A study has been made of Foraminifera in 16 long cores from the eastern Mediterranean Sea and 60 surface sediment samples from the eastern Mediterranean and Aegean seas. In an appendix, 110 benthonic species are discussed of which the following are new: *Bolivina attica*, *Epistominella rugosa convexa*, *Gyroidina delicata*, and *Rotamorphina? involuta*; 18 planktonic species are discussed of which one is new: *Globigerinoides tenella*.

2. The surface water layer, derived from the western Mediterranean, is about 200 m. deep, the intermediate water layer about 200—700 m., the transition (to deep) water layer 700—1600 m., the deep water layer, derived from the Adriatic Sea, 1600 m. and deeper. Mean surface water temperatures are 16—24° C in the Ionian Basin, 16—29° C in the Levantine Basin and 12—25° C in the Aegean Sea, with minimum temperatures in February-March and maximum in July—August. In all areas the temperature variation decreases with depth down to 500 m. (and deeper) where it is *ca.* 1° (13—14° C). Surface water salinities in the eastern Mediterranean are *ca.* 38 $^0/_{00}$ except at nearshore stations where they may be much lower due to local conditions. In the Aegean they are *ca.* 30 $^0/_{00}$ in the north and 39 $^0/_{00}$ in the south near Crete. Deeper salinities in the whole area are near 38—39 $^0/_{00}$.

3. Planktonic Foraminifera are found in all surface sediment samples except the one from Piraeus Harbor. Progressing from shallow

to deep water the species appear approximately in the order of their frequency in deep sediments. An exception is *Globigerina pachyderma* postulated to be a deep-living species. The ratio of planktonic population to total foraminiferal population increases from 3 % at 51 m. to 21—98 % deeper than 500 m., and greater than 99 % deeper than 1300 m.

4. The modern planktonic fauna is probably largely indigenous due to a barrier near Gibraltar caused by a temperature change and/or other factors. Species present in the adjacent Atlantic are absent in the Mediterranean and vice versa. This applies also to core faunas in the two areas. In the eastern Mediterranean the fauna shows an increase in warm-loving species over the western due to the higher temperatures obtaining there. In the Aegean Sea the faunas reflect the cooler conditions.

5. In the surface sediments four depth assemblage boundaries based on benthonic species are found: bay-open ocean, 143—205 m., 500—700 m., and 1000—1300 m. Except for the first, these boundaries coincide approximately with the water layer boundaries. The assemblages are similar to those of other areas at analogous depths except for the deepest one which contains an unusually sparse fauna.

6. Badly preserved, glauconite-filled specimens give evidence of non-depositional conditions at some localities. Displaced shallow species are found at some deep stations near coastal areas.

7. Benthonic populations in the cores are relatively small, the largest being in core sections believed to reflect cooler climates or sections containing specimens displaced from shallow water. »Floods» of species such as *Bulimina aculeata*, *Globobulmiina*? sp. and *Pyrgo serrata* occur occasionally. The most common species are *Articulina tubulosa* and vars. and *Miliolinella circularis*. Displaced shallow specimens are most common in cores near shallow coastal areas.

8. The planktonic populations in the cores are usually large and show little solution of calcium carbonate tests. It is suggested that sections containing few or no planktonic specimens represent times of rapid sedimentation. The top samples of most cores contain faunas analogous to the modern ones although the upper sections (less than one meter) may be missing. Constituents of the faunas believed to reflect climatic temperature variations have been analyzed. The »warm» fauna which reflects relatively warm conditions consists of *Globigerinella aequilateralis*, *Globigerinoides rubra* s. s., *G. sacculifera*, and *Hastigerina pelagica*. The »cold» fauna which reflects relatively cooler conditions consists of *Globigerina pachyderma* and *Globorotalia scitula*. Other species also appear to reflect temperature changes but this has not yet been observed for these species in other areas. The frequencies of such species as *Globigerina eggeri* and *G. inflata* appear to reflect, to a great extent, factors other than temperature. In most cores the planktonic faunas reflect the occurrence of two long cold intervals separated by a short warm one and preceded (in time) by a long fluctuating warm interval.

9. *Globorotalia truncatulinoides* is left-coiling in the modern sediments. In the cores it shifts to right coiling shortly above the end (in time) of the uppermost cold interval. Occurrences are sparse but show several fluctuations in the cores down to the lower part of the second long cold interval (from the top) where the species is much commoner and the direction of coiling fluctuates several times. In the long warm interval below it is even more abundant and coiling direction fluctuates more frequently.

10. The temperatures calculated from isotopic data for Core 189 by Emiliani (1955 b) show fluctuating curves very similar to those of the »warm» and »cold» planktonic faunas. It is suggested that the absolute temperature values obtained by isotopic nethods may be invalid due perhaps to the presence of Zooxan-

thellae in the living forms which may exchange oxygen with the calcium carbonate test of the host.

11. It is suggested that the two long cold intervals reflected by the planktonic core faunas represent the Last Glaciation (Würm I, II, III) and the long warm interval preceding them the Last Interglacial (Riss/Würm). A comparison is made with the previous interpretation of Emiliani (1955 b).

12. Correlations of the cold and warm intervals made between cores agree well with correlations made by other workers using other criteria. An exception is the upper volcanic ash bands correlated by Mellis (1954) between cores 187, 188, 189, and 192. The bands in cores 187 and 188 do not appear to correlate with those of cores 189 and 192.

13. The upper sections of a few cores contain a »warm» fauna having a higher frequency than that of modern sediments. This is postulated to reflect the »Climatic Optimum» of ± 5000 years B. P. Sedimentation rates are calculated using this event, the published radiocarbon date for Core 189 of 17200 ± 500 years B. P. and the points in the cores reflecting the various postulated climatic events. These rates vary from 22.1 cm./1000 years in the upper part of Core 184 (situated near the Nile Delta) to 5.7 cm./1000 years in that of Core 194. The calculated rates vary in different parts of the cores and it is suggested that they are highly speculative and that uniform sedimentation cannot be assumed even for short core sections. The highest rates occur in cores 184, 198, and 199.

Introduction

This is one of a series of papers on the Foraminifera from long cores collected by the Swedish Deep-Sea Expedition under the leadership of Prof. Hans Pettersson. It is chiefly concerned with the study of sixteen cores collected under the personal supervision of Prof. Börje Kullenberg in the eastern part of the Mediterranean Sea. In addition, it includes a study of the Foraminifera in sixty surface sediment samples collected in 1948 in the eastern Mediterranean and Aegean seas by the Woods Hole Oceanographic Institution using the Research Vessel ATLANTIS. The writer wishes to give especial thanks to Profs. Pettersson and Kullenberg for their generosity in providing the material from the long cores and assisting in various ways. Thanks are also due to the members of the Woods Hole Oceanographic Institution who provided the surface sediment samples. Mrs. Jean Peirson Hosmer drafted the illustrations and assisted with the laboratory work. This study has been supported by the University of California under contract with the Office of Naval Research.

The purposes of this study are two-fold. The first is the analysis and interpretation of the Foraminifera in surface sediments at various depths. The depth distributions of the various benthonic forms are defined and faunal limits delineated. Further work on the planktonic forms is discussed to augment the results of a previous study (Parker, 1955). It was felt that this work on surface sediments would aid in the study of the long ceras which is the second and main purpose of the paper. This includes the analysis and interpretation of the foraminiferal distributions in the long cores, leading in turn to a discussion of the age and correlation of the sediments. Detailed core descriptions and a section on the systematics of the Foraminifera are given in Appendices A and B respectively.

Locations of Cores and Surface Sediment Samples

The core stations are located along an irregular line starting near the east coast of Sicily and extending eastward south of Crete to a position north of the Nile Delta, turning south

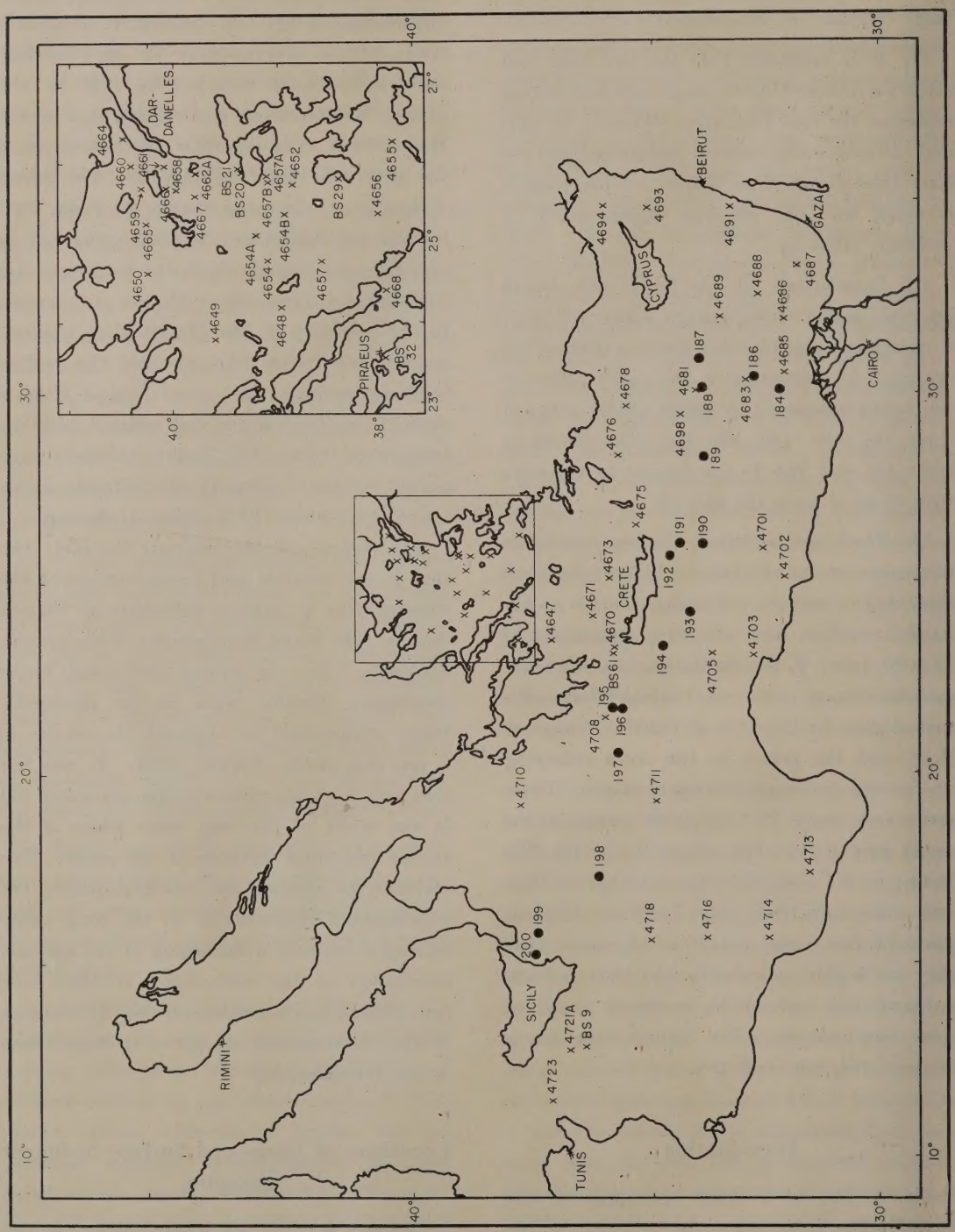


Figure 1. Locations of cores (0) and surface sediment samples (X).

at this point towards the delta. The surface sediment stations are more widely scattered in an area extending from south of Sicily in the west almost to the coast of Israel in the east and northwards into the Aegean Sea, where most of the shallow samples were taken. They range in depth from *ca.* 25 m. to 4667 m. The locations are shown in Figure 1; exact positions and depths are given in Table 1. Koczy (1956, profile 16) gives bottom topography profiles of the core station areas.

Methods of Study

The cores, varying in length from 0.8—11.49 m., were taken with the piston coring tube developed by Kullenberg (1947). They were split in half vertically and samples 0.5 cm. in thickness were taken at approximately 10 cm. intervals. The samples were then trimmed to remove contaminated material caused by drag on the outside of the cores. This procedure was carried out by members of the Oceanografiska Institut in Göteborg. These samples, taken from cores having a diameter of *ca.* 4.5 cm., contain about 7 cu. cm. of sediment. Phleger, Parker, and Peirson (1953) give an average weight of such samples (before washing) of 3 gm. The fine sediment was washed from them through a brass sieve with *ca.* 0.074 mm. openings.

The foraminiferal assemblages of all the core samples were examined but population counts were made only at approximately 50 cm. intervals, including top and bottom samples, unless intervening ones showed faunal change by gross examination. The population counts were made from screened samples obtained by using a sieve with openings of *ca.* 0.149 mm. These were divided with a microsplit (Parker, 1948, p. 218) to give a working sample of approximately three hundred planktonic specimens. The entire sample (> 0.149 mm.) was used in counting the benthonic forms since in most cases they are relatively rare. For this reason on Tables 6—20 benthonic occurrences are given in numbers of specimens rather than in per cent pf total benthonic fauna but the planktonic occurrences are in per cent of total planktonic populations.

The surface sediment samples, with a few exceptions, were taken with a short gravity corer. Sta. B. S. 32 was sampled with an underway bottom sampler, stas. 4649 A, 4657, and B. S. 21 A with an orange peel dredge, and Sta. B. S. 61 with a clam shell sampler. The fine sediment had been removed before we received the material so that equal sized samples could not be used. For this reason estimated total populations are not given in Tables 2 and 3. This is not important since the chief purpose of this part of the study is to obtain data on depth distributions of the species and frequency data on modern planktonic faunas in deep-water sediments for comparison with the core faunas. The technique used in making the population counts is similar to that described for the cores.

TABLE 1. Locations of cores and surface sediment samples.

Cores

No.	N. Latitude	E. Longitude	Depth (m.)
184	32° 12′	30° 13′	1176
186	32° 47′	30° 33′	2025
187	33° 59′	31° 02′	2500
188	33° 55′	30° 17′	2810
189	33° 54′	28° 29′	2664
190	33° 54′	26° 10′	2900
191	34° 24′	26° 11′	3635
192	34° 36′	25° 29′	2680
193	34° 12′	24° 22′	2130
194	34° 48′	23° 29′	3000
195	35° 52′	21° 53′	3665
196	35° 41′	21° 50′	4270
197	35° 47′	20° 42′	2940
198	36° 13′	17° 28′	3555
199	37° 29′	15° 58′	2370
200	37° 33′	15° 24′	2050
Surface sediment samples (from ATLANTIS cruise 151)			
4647	37° 09′	23° 38′	366
4648	38° 56′	24° 18′	338
4649	39° 35′	23° 53′	1265

No.	N. Latitude	E. Longitude	Depth (m.)
4649 A	40° 23′	25° 25′	106
4650	40° 14′	24° 42′	859
4652	38° 50′	25° 52′	201
4654	39° 04′	24° 54′	746
4654 A	39° 12′	25° 13′	115
4654 B	38° 54′	25° 29′	143
4655	37° 50′	26° 25′	1102
4656	37° 59′	25° 31′	680
4657	38° 32′	24° 54′	384
4657 A	39° 05′	25° 58′	104
4657 B	39° 04′	25° 56′	256
4658	39° 58′	25° 47′	82
4659	40° 18′	25° 45′	850
4660	40° 24′	26° 02′	665
4661	40° 05′	26° 04′	75
4662 A	39° 47′	26° 00′	51
4664	40° 28′	26° 25′	658
4665	40° 15′	25° 18′	1587
4666	40° 04′	25° 46′	71
4667	39° 47′	25° 41′	86
4668	37° 54′	24° 33′	117
4670	35° 49′	23° 27′	996
4671	36° 16′	24° 18′	1016
4673	35° 55′	25° 16′	1834
4675	35° 21′	26° 40′	1064
4676	35° 46′	28° 28′	3974
4678	35° 34′	29° 49′	1862
4681	34° 03′	30° 12′	2852
4683	32° 59′	30° 28′	2358
4685	32° 06′	30° 41′	647
4686	32° 06′	32° 05′	799
4687	31° 49′	33° 29′	631
4688	32° 42′	32° 43′	1312
4689	33° 32′	32° 09′	2442
4691	33° 17′	34° 59′	1331
4693	35° 08′	34° 56′	1073
4694	36° 02′	35° 03′	567
4698	34° 24′	29° 34′	2738
4701	32° 33′	26° 03′	2760
4702	32° 05′	25° 16′	799
4703	32° 48′	23° 13′	552
4705	33° 44′	23° 18′	1788
4708	36° 01′	21° 37′	3499
4710	37° 49′	19° 19′	3241
4711	34° 58′	19° 24′	3309
4713	31° 37′	17° 32′	684
4714	32° 30′	15° 49′	665
4716	33° 52′	15° 47′	1378
4718	35° 06′	15° 44′	541
4721 A	36° 49′	12° 54′	179
4723	37° 11.7′	11° 33.5′	567
B. S. 9	36° 28′	12° 55′	731
B. S. 20	39° 19′	26° 00′	210
B. S. 21 A	39° 21′	26° 03′	205
B. S. 29	38° 23′	25° 56′	287
B. S. 32	Piraeus Harbor		*ca.* 25
B. S. 61	35° 51′	23° 16′	462

Foraminifera in Surface Sediment Samples

Temperature and Salinity

The discussion given below is an emendation of one given previously (Parker, 1955). The eastern Mediterranean is separated from the western by a sill, between Sicily and Tunis, having a maximum depth of about 320 m. Water flows into the eastern basin as surface currents, returning westward at intermediate depths. The depth of the surface layer is about 200 m. The deep water according to Pollak (1951) is derived entirely from the Adriatic Sea and not from the Aegean as was previously believed. A comparison of the temperature, salinity, and dissolved oxygen curves for two stations, one in the Ionian Basin, and one in the Levantine Basin, show that above about 1000 m. the curves show great dissimilarity while below this depth they are similar. Pollak says in elaboration (*op. cit.* p. 132), »If the upper limit of the deep water were defined by marked changes in the gradients of the elements plotted, a depth of about 700 m. is the boundary layer. On the other hand, if absolute values are used as criteria, 1600 m. gives a rigorous upper limit for the deep water.» He considers the depth zone from 700—1600 m. one of transition between intermediate and deep water. He shows that the deep water derived from the Adriatic Sea is a mixture of relatively fresh water, largely river effluent from the northern Adriatic, and of Ionian Sea water of relatively high salinity from intermediate depths.

Surface currents enter the Aegean Sea from the Mediterranean to the southeast and the Black Sea to the northeast setting up a counterclockwise surface circulation.

In the eastern Mediterranean surface temperatures vary from 16° C to 24° C in the Ionian Basin to the west and 16° C to 29° C (Rouch, 1945) in the eastern part of the more easterly Levantine Basin, the lowest temperatures occurring in February—March and the highest

in July—August. South of Sicily a winter maximum of *ca.* 14° C is reached (Guyot, 1951). Surface salinities vary from *ca* 38 ‰ in the west to *ca* 39.5 ‰ in the east although local variations may occur nearshore such as a salinity of 30 ‰ found near Gaza, Israel, in September, 1947, probably due to a Nile flood (Oren, 1952). Surface temperature in the Aegean Sea vary from *ca.* 12—25° C, surface salinities from *ca.* 30 ‰ near the Dardanelles (or even lower nearshore, Rouch, 1940) to 39 ‰ north of Crete.

There is less detailed information on salinities and temperatures in deeper water. Most of the following dato are taken from the *Bulletin Hydrographique, Copenhagen,* (1952) for the year 1948 and *Praktika of the Hellenic Hydrobiological Institute, vol.* 3, *no.* 3, *Piraeus* (1949) for the years 1947 and 1949. Temperatures for depths from 25 m. to 500 m. in the Aegean Sea, where most of the samples shallower than 500 m. were obtained, are:

Depth in Meters	Temperatures °C	
	Max.	Min.
25	11	21—
50	12+	21—
100	13+	18—
200—300	13+	16
400	14+	15
500	*ca.* 14	*ca.* 14

Deeper than 500 m. temperatures in both the eastern Mediterranean and Aegean seas are 13—14° C.

Salinities of water deeper than 25 m. in the southern Aegean and eastern Mediterranean usually vary between 38 ‰ and slightly greater than 39 ‰. This is not true, however, of all nearshore stations, especially in the northern Aegean where salinities of 37 ‰ or even less may occur at 25 m. due to the outflowing Black Sea water. In such cases there is a rapid increase deeper so that at 100 m. salinities are greater than 38 ‰.

Planktonic Foraminifera

General statement. The characteristics of the planktonic faunas of the deep-water surface sediments have been given previously (Parker, 1955). Since then two additional species have been recognized: *Globigerina radians* Egger and *Globigerinoides tenella*, n. sp. The systematic discussion of all the species is given in Appendix B. Data on the shallow-water samples (< 500 m.) and emended data on two deep-water samples are given in Table 2. in per cent of total planktonic population. In addition, for each station the per cent of planktonic to total foraminiferal population is given. Sta. B. S. 61 is omitted since there is evidence of large-scale faunal displacement from shallow water at that locality.

Planktonic specimens are found at all the shallow Aegean Sea stations except that in Piraeus Harbor. At 51 m. they form 3 % of the total foraminiferal population. This percentage increases with depth until a maximum of 99 % is reached at about 1300 m. Variable amounts occur deeper than 500 m. (21—98 %).

The order of appearance of planktonic species from shallow to deep water is as follows: at 51 m. *Globigerina bulloides, G. inflata,* and *Globigerinoides rubra;* at 71 m. *Globigerina digitata, G. quinqueloba,* and *Globigerinoides tenella;* at 75 m. *Globigerinoides sacculifera* and *Orbulina universa;* at 82 m. *Globigerina eggeri;* at 86 m. *Globigerinita glutinata;* at 104 m. *Globigerinella aequilateralis;* at 143 m. *Hastigerina pelagica;* at 287 m. *Globigerina radians;* at 338 m. *G. pachyderma;* at 366 m. *Globorotalia truncatulinoides* (rare in Aegean Sea); and at 859 m. *G. scitula* (rare in Aegean Sea).

The planktonic faunas of the two deep stations (Table 2) are believed to be typical of the faunas found at the two extremities of the eastern Mediterranean. They are given for comparison with the »top» faunas of the long cores. There is some variation in the

populations of the deep-water sediment samples (*vide* Parker, 1955) but those at stas. 4681 and 4711 appear to be representative and contain fresh-looking specimens of apparently modern deposition. Sta. 4711 has the more complete fauna but rare occurrences not previously observed are listed for sta. 4681. Such occurrences are spasmodic and their inclusion in population counts of 300 specimens is a matter of chance. *Globigerinoides tenella* was previously included in *G. rubra* which now has a somewhat lowered frequency. »*G. rubra*, etc.» in Table 2 contains more than one species (*vide G. rubra* in Appendix B) but *G. rubra* s. s. makes up a large part of the specimens. *Globigerinella aequilateralis* has an increased frequency in the population recounts due to a greater understanding of the juvenile forms, some of which were previously included in other species. Further work on the life histories of the planktonic forms will undoubtedly lead to an even greater understanding of juvenile specimens.

Discussion. The modern planktonic fauna is similar to the core faunas believed to reflect the warmer climates of interglacial or interstadial times. The latter, however, vary in degree. As stated previously (Parker, 1955) the modern fauna is warmer in type than that of the western Mediterranean as shown by an increase in the frequencies of *Globigerinoides sacculifera* and *Hastigerina pelagica* and the decreased frequencies of *Globigerina bulloides*, *G. inflata*, and *Globorotalia truncatulinoides*. The Aegean Sea fauna, on the other hand, reflects the somewhat cooler conditions found there by the decreased frequencies of *Globigerinoides sacculifera* and *Globigerinella aequilateralis* and the increased frequency of *Globigerina bulloides*. The strong increase of *G. eggeri* frequencies shown earlier (Parker, 1955) is now believed to be erroneous since many of the small specimens originally identified as *G. eggeri* are now interpreted as atypical forms of *G. bulloides*.

The higher temperatures of the eastern Mediterranean have not led to the introduction of species found in the Atlantic west of Gibraltar, which are believed to be excluded from the western Mediterranean because of the decrease in surface water temperatures. These are *Globorotalia hirsuta*, *G. punctulata*, and *Pulleniatina obliquiloculata*. On the other hand, *Globigerinoides conglobata* which is also absent in the western area is found rarely in the eastern and occurs frequently in the long cores. The fauna appears to be largely an indigenous one and even the »warmest» core faunas do not contain species which might be expected if they were not excluded by some barrier. Examples are *Pulleniatina obliquiloculata* and *Globorotalia menardii*. The former does not occur in the adjacent Atlantic at the present time but is found in Core 215 which was taken near the Canary Islands (Phleger, *et al.*, 1953). Similarly *P. obliquiloculata* is found in surface sediments and cores in the adjacent Atlantic. That the barrier is not necessarily caused by temperature changes is shown by the presence in the Mediterranean of *Globigerina quinqueloba* and *Hastigerina pelagica*, both absent west of Gibraltar. The former prefers warm water, the latter cold. It is possible that future work will show that they have been overlooked in the Atlantic area.

The order of appearance of the species in sediments ranging from shallow-water to deep-water is approximately analogous to their frequency in deep samples. This means that the most common species appear first in the shallowest stations: *Globigerina bulloides* and *Globigerinoides rubra*. These are followed quickly by *Orbulina universa* and *Globigerinoides sacculifera*. Some exceptions to this rule occur, however: *Globigerina digitata*, a relatively uncommon form, is one of the first to appear whereas *G. pachyderma* which is relatively common does not occur until a depth of 338 m. It is suggested that the

latter species may live in a deeper layer of water than most other planktonic species.

Benthonic Foraminifera

General statement. There have been many publications on the benthonic Forminifera of the western Mediterranean but very few on those of the eastern area. The latter are entirely descriptive, dealing with the systematics of the species with little or no data on distribution, and were written in the early days of foraminiferal study. Batsch (1791), Fichtel and Moll. (1798), d'Orbigny (1826) and Fornasini (various papers) described the fauna of Rimini, Italy. This fauna was believed to be a Recent one but probably contains re-worked specimens from nearby Pliocene and Pleistocene outcrops. Sidebottom (1904—1909) described Foraminifera from the shores of the Island of Delos. No work has been done on ecological or distributional lines commensurate with that of Colom (1942), Ruscelli (1949), Giunta (1955) and others in the western area. In order to have some criteria for detecting displaced faunas in the long cores and hence the reliability of the core faunas for establishing geological history of the core sediments, an intensive study was made of the benthonic Foraminifera in the surface sediments. Table 3 gives the distribution of the benthonic species in per cent of total benthonic population with the stations arranged in order of depth, regardless of location. A few stations which contain specimens obviously displaced from shallow water have been listed separately on the right so that the depth distributions will stand out more clearly. All species occurring at frequencies lower than 0.2 % have been omitted. In addition, all species occurring only rarely, unless they are common in the long cores, are omitted. The resulting fauna, therefore, represents only a part of the species occurring in the area although it forms the major part of the foraminiferal population. Most of the omitted species are from relatively shallow water and, in some cases, have been listed in generic or family groups where such groups appear to have ecological significance. These include Peneroplidae, Miliolodae, *Rosalina* spp., and *Elphidium* spp.

Depth distribution. Five faunal depth assemblages can be defined in the area. More detailed sampling in the open-sea region shoaler than 200 m. might add to this number. The boundaries between these assemblages occur between the Piraeus Harbor station and the first open-sea station at 51 m., at 143—205 m., at 500—700 m., and at 1000—1300 m. Many distributional changes occur between these depths but there are more at these boundaries which give the assemblages within them a relatively uniform character.

Depth Assemblage 1.

This assemblage is represented at only one station located in the harbor at Piraeus. The temperature limits are *ca.* 11—21° C at 25 m. and the salinity *ca.* 39 ‰. The depth of the station is unknown but it is believed to be shallower than 25 m.

The representatives of the Family Peneroplidae are confined to this assemblage. The following species also occur although they are found deeper also:

Asterigerinata mamilla
Cibicides lobatulus
Elphidium advena
E. complanatum
E. crispum
E. cf. *E. minimum*
Miliolidae — many species
Miliolinella circularis
Neoconorbina terquemi
Planorbulina mediterranensis
Reussella spinosissima
Rosalina globularis bradyi
R. obtusa
Rotalia granulata

Spiroloculina grata
Streblus beccarii and variants
Textularia calva

The most abundant species in this assemblage are:

Asterigerinata mamilla (4 %)
Cibicides lobatulus (5 %)
Elphidium crispum and variants (6 %)
Miliolidae species (40 %)
Peneroplidae (6 %)
Planorbulina mediterranensis (13 %)
Rosalina obtusa (7 %)

The assemblage shows many similarites to the »*Posidonia caulini*» fauna of Colom (1942) which occurs shallower than 32 m. in the Bay of Palma, Majorca.

Depth Assemblage 2. 51 m. ± to 143—205 m.

The shallow limit of Assemblage 2 is represented here by the station at 51 m. and may in reality occur shallower. The temperature limits are about 12—20° C at 50 m., and 13—16° C at 200 m. The salinities are in most cases 38—39 ‰.

The following species are confined to this assemblage:

Astrononion stelligerum
Bolivina subaenariensis (rare)
Bulimina aculeata (1 sta. only — in the cores it is sometimes common with no evidence of displacement from shallow water)
Elphidium granosum
E. pulvereum
Gypsina vesicularis
Neoconorbina williamsoni (occurs rarely — probably more widespread in depth distribution)
Nonion sp. B
Parrellina verriculatum
Rosalina spp.
Spirillina wrightii
Stomatorbina concentrica

The following additional species have their shallow depth limit between 50—82 m.:

Bigenerina nodosaria
Bolivina attica
B. catanensis
Bulimina costata
B. gibba
B. marginata
Cassidulina carinata
C. cf. *C. oblonga*
Eponides repandus
Gavelinopsis praegeri
Hanzawaia rhodiensis
Höglundina elegans
Lagenonodosaria scalaris
Nonion barleeanum, etc.
Nonionella turgida
Pullenia quinqueloba
Pyrgo anomala
Pyrgoella sphaera (1 sta. only)
Quinqueloculina aff. *Q. lamarckiana*
Robulus spp.
Rosalina aff. *R. columbiensis*
Sigmoilina distorta
Siphotextularia concava
Sphaeroidina bulloides
Spirillina vivipara
Spiroloculina angulosa
S. canaliculata
Textularia conica
T. sagittula
Uvigerina mediterranea
Valvulineria complanata

The following species have their shallow depth limit between 104—177 m.:

Biloculinella labiata
Bolivina difformis
B. dilitata dilitatissima
B. pseudoplicata
Cassidulina crassa
Cibicides aff. *C. floridanus*
Glomospira charoides
Gyroidina cf. *G. neosoldanii*
G. umbonata

Hyalinea balthica
Planulina ariminensis
Pseudoclavulina crustata
Siphonina reticulata

The following species do not occur deeper than 143—205 m. and are, thereforé, confined to Assemblages 1 and 2:

Astrononion stelligerum
Elphidium advena
E. complanatum
E. crispum
E. cf. *E. minimum*
Reussella spinosissima
Rosalina globularis bradyi
Rotalia granulata
Streblus beccarii and variants

The species which make up the greater part of the faunal population in Assemblage 2 are as follows:

Asterigerinata mamilla (up to 13 %)
Bolivina catanensis (up to 8 %, continues deeper)
Cassidulina carinata (up to 14 %)
C. cf. *C. oblonga* (up to 9 %)
Cibicides lobatulus (up to 15 %)
Elphidium complanatum (up to 7 %)
E. crispum (up to 7 %)
Hanzawaia rhodiensis (up to 7 %)
Miliolidae (up to 14 %)
Neoconorbina terquemi (up to 7 %)
Textularia sagittula (up to 9 %)

Depth Assemblage 3. 143—205 m. to 500—700 m.

The temperature limits are 13—16° C at 200—300 m., 14—15° C at 400 m.; at 500 m. there is a fairly stable temperature of *ca.* 14° C. The salinities are about 38—39 ‰.

The species confined to Assemblage 3 are:

Angulogerina angulosa
Globobulimina subspinescens (500—600 m.; also listed in Assemblage 4)
Loxostomum alatum

The following species have their shallow depth limit between 143—205 m.:

Cassidulina subglobosa
Gyroidina altiformis
Involutina cf. *I. planorbis*
Robertina translucens
Sigmoilina schlumbergeri
S. tenuis
Spirophthalmidium acutimargo
Uvigerina auberiana

The following species do not occur deeper than 500—700 m.:

Angulogerina angulosa
Bolivina attica
B. catanensis
B. difformis
Bulimina gibba
Eponides repandus
Nonion sp. B
Nonionella turgida
Planorbulina mediterranensis
Pyrgo anomala
Rosalina aff. *R. columbiensis* (1 exception)
R. suezensis
Siphotextularia concava
Spiroloculina angulosa (1 exception)
Textularia calva
T. conica
T. sagittula

The following species, which in most cases have their highest frequencies in Assemblage 3, form the greater part of the population:

Bolivina catanensis (up to 8 %, also common shallower)
Bulimina costata (up to 16 %)
B. marginata (up to 13 %)
Cassidulina crassa (up to 7 %)
Cibicides aff. *C. floridanus* (up to 10 %)
Gyroidina altiformis (up to 15 %, also common deeper)
Nonion barleeanum, etc. (up to 24 %, also common deeper)
Planulina ariminensis (up to 5 %)

Uvigerina mediterranea (up to 37 %, also common deeper)

Depth Assemblage 4. 500—700 to 100—1300 m.

The temperatures at these depths are 13—14° C and the salinities slightly less than 39 ‰. Depth Assemblage 4 occurs chiefly in the transitional zone between intermediate water and deep water defined by Pollak (1951).

The species apparently confined to this assemblage are:

Bolivina albatrossi
Chilostomella mediterranensis
Cibicides wuellerstorfi (1 sta. only)
Globobulimina pseudospinescens (500—600 m., also listed in Assemblage 3)
Lenticulina peregrina
Patellina corrugata
Rotamorphina ? involuta

The following additional species have their shallow depth limit in Assemblage 4:

500—600 m.

Epistominella rugosa convexa
Glomospira cf. *G. gordialis*

600—700 m.

Articulina tubulosa and variants

1000—1300 m.

Cibicides wuellertorfi

The following species do not occur deeper than 700—800 m.:

Bigenerina nodosaria
Hyalinea balthica
Neoconorbina terquemi
Pseudoclavulina crustata
Sigmoilina distorta
Uvigerina auberiana
Valvulineria complanata

The following species do not occur deeper than 800—1000 m.:

Cassidulina carinata
C. cf. *C. oblonga*
Lagenonodosaria scalaris
Spirillina vivipara
Spiroloculina grata

The following species do not occur deeper than 1000—1300 m.:

Biloculinella labiata
Bolivina dilitata dilitatissima
Bulimina marginata
Cassidulina crassa
C. subglobosa
Cibicides lobatulus
Gavelinopsis praegeri
Gyroidina umbonata
Hanzawaia rhodiensis
Höglundina elegans
Planulina ariminensis
Pullenia quinqueloba
Quinqueloculina aff. *Q. lamarckiana*
Robulus spp.
Sigmoilina schlumbergeri
S. tenuis
Siphonina reticulata
Sphaeroidina bulloides
Spiroloculina canaliculata
Spirophthalmidium acutimargo
Uvigerina peregrina (1 sta. only)

The following species occur at high frequencies and make up a large part of the population of Assemblage 4:

Bolivina dilitata dilitatissima (up to 6 %, scattered)
Glomospira charoides (up to 20 %)
G. cf. *G. gordialis* (up to 10 %)
Gyroidina altiformis (up to 34 %)
G. cf. *G. neosoldanii* (up to 67 %)
Höglundina elegans (16 % at 1016 m.)
Involutina cf. *I planorbis* (up to 7 %)
Nonion barleeanum, etc. (up to 42 %)
Uvigerina mediterranea (up to 48 %

Depth Assemblage 5. 1000—1300 to 3974+ m.

There are no stations from 1378 m. to 1788 m. but the assemblage established between 1000 and 1300 m. shows no marked changes shallower

than 2358 m. and therefore it is belived that no important change occurs within the unrepresented depths. This assemblage lies in the deep water zone of Pollak (1951). The temperatures are 13—14° C and salinities 38—39 ‰. The fauna is make up of about twenty-two species (excluding a few species listed as »miscellaneous spp.»). The occurrence of these is very irregular and some samples contain only one or two of them. In addition, species may be very common at one station and entirely absent in adjacent (by depth) ones. Similar scattered occurrences are found in the core samples which theoretically should contain species of this depth assemblage. The species with the highest frequencies and most consistent occurrences are:

Glomospira charoides (up to 100 %)
Gyroidina altiformis (up to 23 % shallower than 2738 m.)
G. cf. *G. neosoldanii* (up to 82 % shallower than 2760 m.)
Uvigerina mediterranea (up to 25 %)

The following species occur spasmodically at high frequencies:

Articulina tubulosa and variants
Bulimina costata
Cibicides aff. *C. floridanus*
Glomospira cf. *G. gordialis*
Involutina cf. *I. planorbis*
Nonion barleeanum, etc.
Virgulina complanata
V. mexicana

Discussion.

The similarity of the fauna at the Piraeus Harbor station to that of the Bay of Palma shallower than 30 m., described by Colom (1942), has already been mentioned. The deeper fauna, from 40—50 m., in the Bay of Palma characterized by high frequencies of Textulariidae has no exact analogy in the eastern Mediterranean samples studied. The faunas at 50 m. and 500 m. in the Ligurian Sea studied by Ruscelli (1949) are analogous to eastern Mediterranean faunas at these depths. Similarly the faunas at 57 m. and 135 m. studied by Giunta (1955) are similar in many ways to those of Assemblage 2 although there are some differences such as higher frequency occurrences of *Bulimina aculeata* and *Valvulineria bradyana* (Fornasini) (probably the species here identified as *V. complanata*). Table 4 gives some comparisons of the depth assemblages established here with those of other areas. When the assemblage boundary depths given are not sharp (i. e. 50—100 m.) an average is given (i. e. 75 m.) for simplification.

The species characteristic of these are not necessarily the same but in most cases they are similar. In the eastern Mediterranean surface sediment samples some forms do not range as deeply as they do elsewhere. These species, however, occur in core samples which show no evidence of the presence of displaced material. This points to the possibility that the sampling of the deeper surface sediments in this area is not completely representative. Some of these species are:

Bolivina albatrossi
B. catanensis
B. dilitata dilitatissima (Medit. only)
Bulimina marginata
Cassidulina carinata
C. crassa
C. cf. C. oblonga
Chilostomella mediterranensis (Medit. only)
Gavelinopsis praegeri
Globobulimina pseudospinescens
Loxostomum alatum
Pyrgo anomala
Quinqueloculina aff. *Q. lamarckiana*
Sigmoilina tenuis
Spiroloculina canaliculata
Spirophthalmidium acutimargo
Valvulineria complanata

Table 4 shows that eastern Mediterranean depth assemblages follow a pattern similar to those of other areas. Assemblage 2 (51 to 143—

TABLE 4. Comparative depth assemblages in various areas (depths are in meters).

	I	II		III		IV	V	
E. Mediterranean	Bay	50(?)—174		174—600		600—1150	1150—3974+	
W. Coast of Africa (Colom, 1950)	9—51	53—323		—		623—878	—	
Coast of Galicia (Colom, 1952)	—	15—250		250—450	450—655+	—	—	
E. Coast of U. S. (Parker, 1948).....	0—15	15—90	90—300	300—680		—	—	
(Phleger, 1942)	—	—	—	200—500		500—1000	1000—1500	1500—3000+
Gulf of Mexico NW (Phleger, 1951) ..	—	18?—100	100—200	200—625		625—1150	1150—1900	1900—3000+
NE (Parker, 1954) ...	—	12?—90	90—140 / 140—200	200—425		425—950	950—3000+	
W. Coast of U. S. (Natland, 1933).....	Lagoon (0.3—2)	4—38	38—274	274—1981			1981—2441+	

205 m.) coincides approximately with the isothermal seasonal layer; Assemblage 3 (143—205 to 500—700 m.) coincides with the main thermocline or intermediate-water layer; Assemblage 4 (500—700 to 1000—1300 m.) coincides approximately with the transition zone between intermediate and deep water (*vide* Pollak, 1951); Assemblage 5 (deeper than 1000—1300 m.) coincides approximately with the deep-water layer (*vide* Pollak, 1951). The water of these various layers has different properties and is derived from different sources. The key differences affecting the Foraminifera are unknown although temperature is generally believed to be one of the most important in open-sea environments.

Non-depositional areas. At some stations the specimens are badly preserved and frequently filled with glauconite. This suggests that deposition at these localities is slow and the faunas are, therefore, not necessarily modern. Such conditions are found to a marked degree at stas. 4657 A, 4652, B. S. 61, 4718, 4703, 4702, and 4671. The faunas, both planktonic and benthonic, however, appear to be analogous to the modern ones.

Displaced faunas. Seven samples containing a significant number of displaced specimens are listed separately in Table 3. Additional samples may contain a few displaced specimens. Examples are the occurrences of *Reussella spinosissima* and *Sigmoilina distorta* at Sta. 4711. Displacements can be easily detected when known shallow species are moved into deep water. When a deep-water sample is seen to contain several of these it is suspect and all occurrences should be distrusted. When short range displacement occurs it is difficult to detect and there may be many more such displacements than are realized.

The seven stations showing a large amount of displacement (*vide* Table 3) are B. S. 61, 4703, 4659, 4675, 4655, 4691, and 4665, ranging in depth from 462 m. to 1587 m. All these are in moderately deep water very close to the coast: Sta. 4691 near Israel, Sta. 4703 near Libya, Stas. 4675 and B. S. 61 near Crete, Stas. 4655 and 4659 near Turkey, and Sta.

4665 near the Island of Samothrace. At these localities there must be relatively steep gradients from shallow to deep water and, therefore, they are ideal places for displacement by slumping or turbidity currents. These samples also contain species which are normal for their depths.

Foraminifera in Cores

The distributions of the planktonic and benthonic populations in the cores are given in Tables 6—20 (*vide* Appendix A). The planktonic species are recorded on a percentage basis, the benthonic in numbers of specimens present. The benthonic populations are usually small and percentage calculations are invalid. In general, data are given for each 50 cm. of depth in the core unless changes occur at shorter intervals. The total abundance of planktonic specimens larger than 0.149 mm. diameter has been estimated for each sample. These estimates do not necessarily reflect the ratio of calcium carbonate present since many samples contain very large populations of relatively small specimens, even within the limits studied.

Benthonic Foraminifera

Systematic discussions of the benthonic species and data on their occurrence in the cores are given in Appendix B. The benthonic populations are very small relative to the planktonic, the largest populations usually being found in the core sections believed to reflect colder climates. In most of the cores, samples containing more than one hundred benthonic specimens are the exception and usually the number is far less but Cores 184 and 192—194 consistently contain more specimens than the other cores. Core 184 was taken at the shallowest station, 1176 m., and, therefore, comes within the limits of Depth Assemblage 4 where the abundance of benthonic specimens is greater than in Assemblage 5. Cores 192—194 contain many specimens apparently displaced from shallow depths. Such samples usually have larger benthonic populations, an extreme case being sample 73 in Core 188 which has a population of 1981 specimens.

Occasionally core samples contain »floods» of a single species. Examples are the occurrences of *Bulimina aculeata* in Core 189, sample 77 (1280 specimens) and 85 (896 specimens), and Core 190, sample 91 (768 specimens). The upper occurrence in Core 189 may correlate with that of Core 190. Other examples are the occurrences of *Globobulimina* ? sp. in Core 189, sample 47 (86 specimens), and *Pyrgo serrata* in Core 193, sample 36 (94 specimens). The writer has not previously encountered such single species »floods» in cores and the reason for them is unknown. Miss Ruth Todd (personal communication) postulates a semi-planktonic habit for similar occurrences of *Globobulimina affinis* and *Chilostomella oolina*, in western Mediterranean cores.

The species which occur most consistently and abundantly are: *Articulina tubulosa* (and variants) found deeper than 684 m. in the surface sediments and *Miliolinella circularis* which occurs in the surface sediments at all depths.

Many cores contain specimens which have obviously been derived from shallow sediments. Many other displaced occurrences probably also occur but are difficult to detect. The method used for determining which species are displaced is similar to that described by Phleger, *et al.* (1953, p. 24). Populations containing known shallow species were analyzed. Associated species with somewhat deeper depth ranges found only in such assemblages are also considered to be displaced. Samples containing such species sometimes are also richer in species known to live in a deep habitat, but the reason for this is obscure. The species in the cores believed to be displaced from shallow water are given below, with their depth ranges in the surface sediments.

Asterigerinata mamilla (bay—179 m.)
Astrononion stelligerum (51—143 m.)
Biloculinella labiata (106—1378 m.)
Bolivina attica (82—338 m.)
B. difformis (115—567 m.)
Cibicides lobatulus (bay—1265 m.)
Elphidium advena (bay—179 m.)
E. complanatum (bay—205 m.)
E. crispum (bay—338 m.)
E. granosum (51—201 m.)
E. cf. *E. minimum* (bay—179 m.)
E. pulvereum (106—201 m.)
E. spp.
Gyroidina umbonata (205—1016 m.)
Hanzawaia rhodiensis (51—1378 m.)
Lagenonodosaria scalaris (82—996 m.)
Lenticulina peregrina (567—1016 m.)
Nonion sp. A (not observed in surface sediments)
N. sp. B (51—567 m.)
Nonionella turgida (86—567 m.)
Parrellina verriculata (51—201 m.)
Planorbulina mediterranensis (bay—256 m.)
Planulina ariminensis (106—1016 m.)
Pullenia quinqueloba (82—1265 m.)
Reussella spinosissima (bay-117 m.)
Rosalina aff. *R. columbiensis* (51—201 m.)
R. globularis bradyi (bay—143 m.)
R. obtusa (bay—996 m.)
R. suezensis (71—256 m.)
R. spp.
Rotalia granulata (bay—143 m.)
Rotamorphina ? *involuta* (567—996 m.)
Sigmoilina distorta (51—731 m.)
S. schlumbergeri (179—1016 m.)
Siphonina reticulata (104—1016 m.)
Siphotextularia concava (51—631 m.)
Sphaeroidina bulloides (75—1265 m.)
Spirillina vivipara (71—996 m.)
S. wrightii (75—143 m.)
Spiroloculina angulosa (71—541, 1016 m.)
S. grata (bay—859 m.)
Streblus beccarii and variants (bay—179 m.)
Textularia conica (51—631 m.)
T. sagittula (51—366, 731 m.)
Uvigerina auberiana (179—731, 1265 m.)

The following are questionably displaced when found in the cores, since there are some occurrences where displacement cannot be proved:

Angulogerina angulosa (179—731 m.)
Bulimina gibba (71—658 m.)
Hyalinea balthica (106—799 m.)
Neoconorbina terquemi (bay—799 m.)
N. williamsoni (117—179 m.)
Nonion barleeanum, etc. (51—1265, 1844 m.)
Wiesnerella auriculata (not observed in surface sediments)

The cores having the greatest abundance of displaced specimens are, as is to be expected, those nearest shallow coastal areas. Cores 184, 188, 191—196, 198, 199, and 200 contain such specimens to a greater or lesser degree. All of these, except Cores 188 and 198, are relatively near shore at depths greater than 2000 m., in most cases considerably deeper. Cores 188 and 198 have less displaced material than the others. In Core 188 only one sample (709.5 cm.) contains such material and in Core 198 two (97.5 cm. and 899.5 cm.) with a questionable third zone at the top. Cores 186, 187, 189, 190, and 197 are relatively free of detectable displaced material although very occasional shallow-water specimens are found. There is some evidence, however, in Core 186 of displacement of deeper species which in other cores only occur in association with shallow species but here do not.

Planktonic Foraminifera

Most planktonic specimens in the cores are well preserved, with only occasional samples showing advanced solution of the calcium carbonate tests although many samples contain a few broken specimens. Frequent samples contain few or no planktonic specimens but this

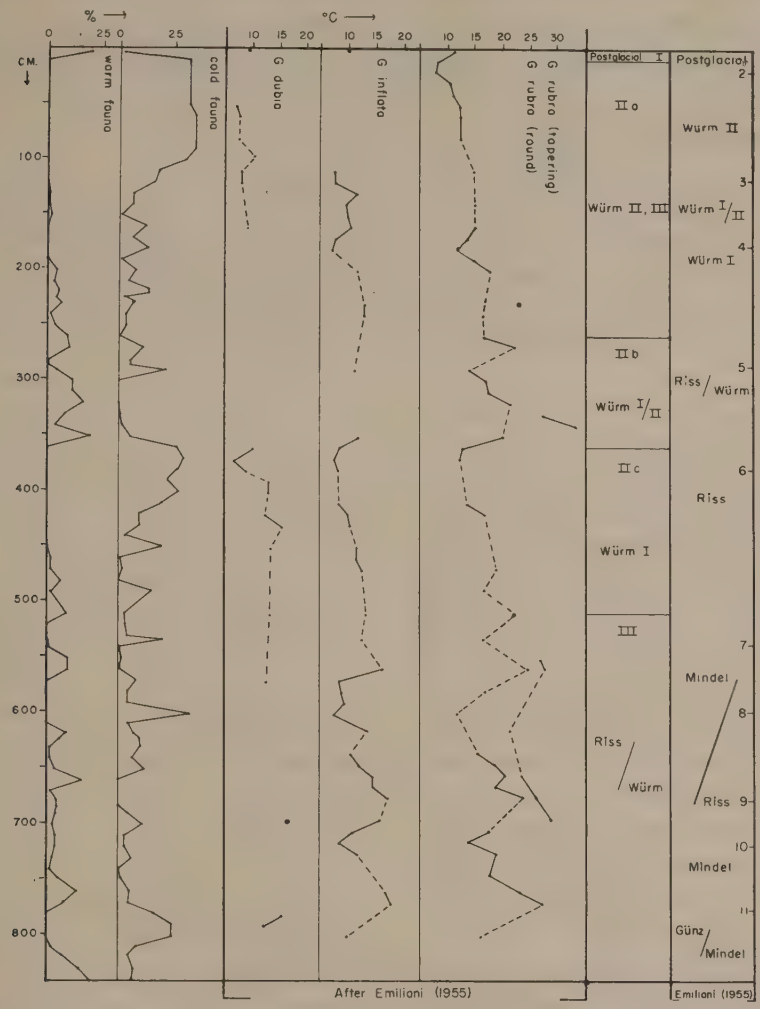


Figure 2. Frequency curves and interpretation of »warm» and »cold» planktonic species-groups in Core 189 compared to Emiliani's (1955) temperature curves based on isotopic data and his interpretation.

scarcity is thought to be due to dilution by relatively rapid sedimentation rather than to removal by solution.

The planktonic species found in the cores are the same as those in the surface sediments with the exception of one occurrence of *Globorotalia punctulata* at a depth of 609.5 cm. in Core 197.

Schott (1935) and Ericson and Wollin (1956 b) have demonstrated that *Globorotalia menardii* (d'Orbigny) is an excellent indicator of the sections in North Atlantic cores deposited in relatively warm intervals and hence that the presence or absence of this species shows the sequence of warm and cold time intervals reflected by the core sediments. Similarly Cushman (1941), Kane (1953), Ovey (in Wiseman and Ovey, 1950), Phleger *et al.* (1953), and others have evaluated various other species as temperature or water mass indicators in the North Atlantic and elsewhere. In the eastern Mediterranean the problem of detecting how planktonic species respond to temperature changes is complicated by the fact that some species appear to be influenced sometimes by other factors. They do not act in rhythm

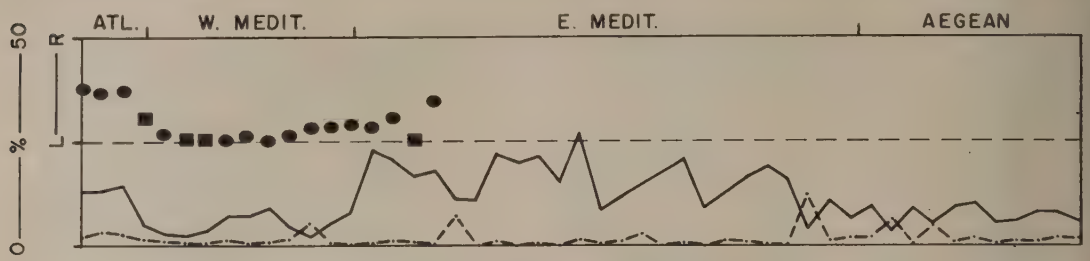


Figure 3. Frequencies of »warm» (solid line) and »cold» (dotted line) planktonic species-groups and coiling directions of *Globorotalia truncatulinoides* in surface sediment samples of the Mediterranean and Aegean seas and the adjacent North Atlantic (● based on more than 100 specimens ■ 30—100).

with others of similar postulated temperature requirements or, conversely, to those of opposite preference. A few species, however, which previous work has shown prefer cold water environments appear to fluctuate in unison and in opposition to a few species preferring warm water environments. The various publications just mentioned provided these data. Some known to favor a warm water environment elsewhere do not occur in the Mediterranean. *Globorotalia menardii* and *Pulleniatina obliquiloculata*, two of the most reliable warm water indicators in the North Atlantic and Gulf of Mexico, are examples. Their absence in even the »warmest» core faunas has been postulated in a previous section as due to the indigenous character of the Mediterranean faunas resulting from the presence of an effective barrier to the invasion of North Atlantic species.

The most reliable indicators of cooler water environments in the cores are *Globigerina pachyderma* and *Globorotalia scitula*; those of warmer environments are *Globigerinella aequilateralis*, *Globigerinoides rubra* s. s., *G. sacculifera* and *Hastigerina pelagica*. Figure 2 gives the frequency curves of these two faunal groups in Core 189, Figure 6 for all the cores (except Core 200). Since the population counts of »*G. rubra*, etc.» (*vide* Tables 6—20) contain several species (*vide G. rubra* in Appendix B) 10 % of »*G. rubra*, etc.» has been added to the »warm» faunal group frequencies when *G. rubra* s. s. is present; this figure may be too high in some cases and too low in others. Since the species appears to be present only during the warmest periods this a mount acts an added »bonus» to the »warm» fauna frequency for the indication of such intervals. Figure 2 also gives the isotopic temperature curves for Core 189 published by Emiliani (1955 b). The agreement of these with the frequency curves of the »cold» and »warm» faunas is striking. Figure 3 gives frequency curves for these same faunas in the surface sediment samples for comparison.

Figures 4 and 5 give the frequency curves of all the planktonic species in Cores 189 and 190. A study of these shows that additional species fluctuate more or less in unison with those of the »warm» and »cold» faunas but they are not included because of the lack of published data on their distribution. The species whose frequency curves agree with those of *Globigerina pachyderma* and *Globorotalia scitula* are *Globigerina quinqueloba* and, to a somewhat less extent, *Globigerinita glutinata*. *Globigerina bulloides* sometimes fluctuates similarly but often independently. This may be due to the inclusion of more than one species in the population counts of this form. The frequency curve of *G. inflata* agrees to a great extent but also shows anomalous fluctuations. The frequency curve of »*Globigerinoides rubra*, etc.» agrees approximately with those of the species of the »warm» group but some of the

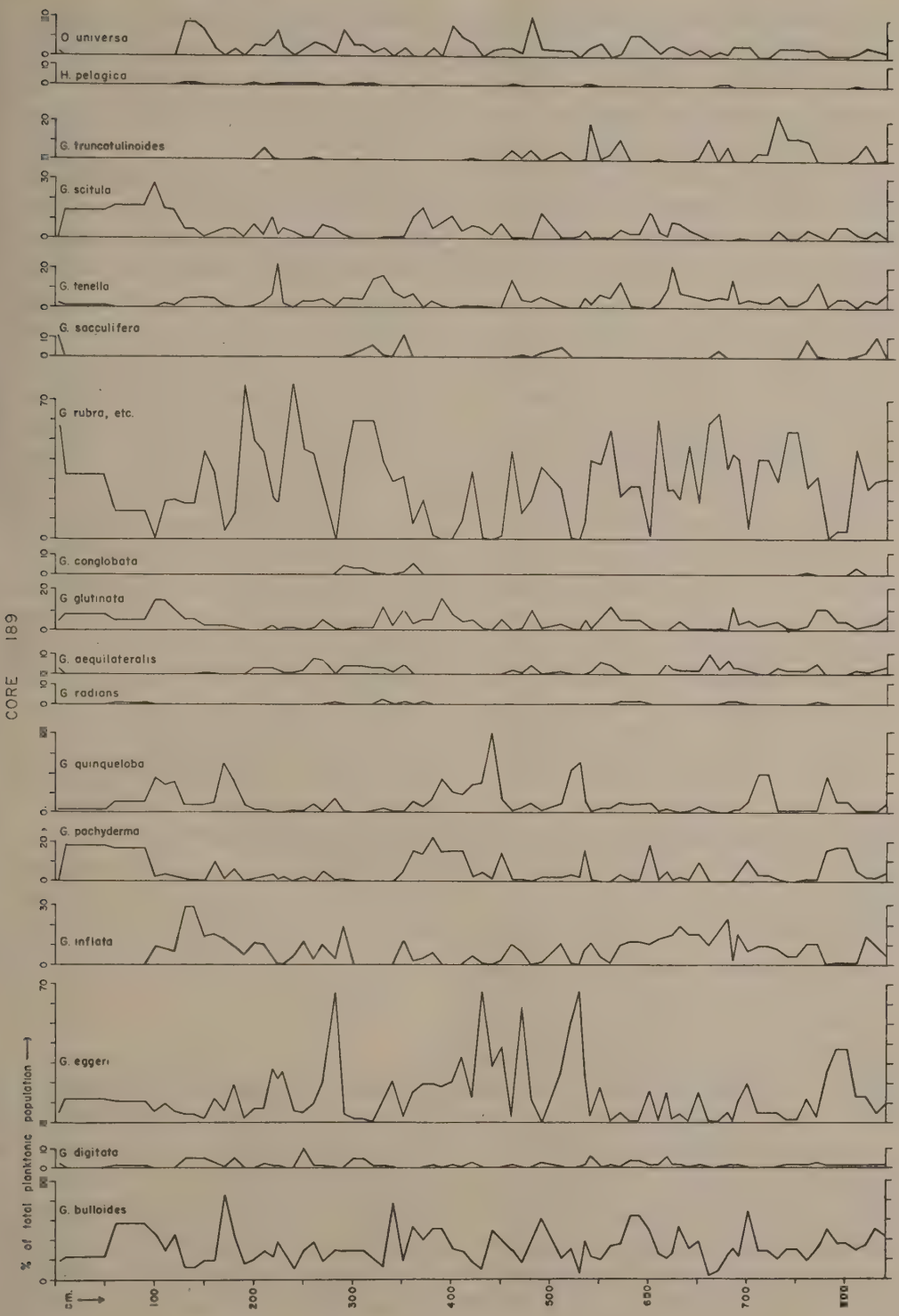


Figure 4. Frequency curves of planktonic species in Core 189.

species included in this category (*vide G. rubra* in Appendix B) may behave differently.

The frequency curve of *Globigerina eggeri*, as previously shown by Kullenberg (1952, »*G. dubia*»), fluctuates in a very individual manner. In some samples this species forms over 50 % of the planktonic population. No firm correlations can be made between cores of these high frequency occurrences although they appear to be in the same general sections. The high frequency of *G. eggeri* in a sample causes a relative scarcity of the diagnostic species but apparently such occurrences are found in sections reflecting both cold and warm intervals.

In general, the core faunas show the presence of two long, cold intervals separated by a short warm one and preceded (in time) by a long warm interval showing one or two cold oscillations which are relatively very short. It is probable that a portion of the top section is missing in most of the cores (Kullenberg, 1955). This loss appears to be relatively small in most cases, probably not exceeding one meter and usually less. All but Core 190 show a short period of warming at the top similar to that shown in North Atlantic cores by various authors (Ericson and Wollin, 1956 a, b; Phleger *et al.*, 1953, etc.). The fauna at the top of Core 190 apparently reflects the uppermost cold interval.

Figure 6 also gives data on the coiling direction of *Globorotalia truncatulinoides*. The coiling directions of various other species were investigated in Core 187 but no significant changes occurred. These species showed the following coiling directions throughout the core;: *Globigerina eggeri* 99—100 % right coiling *G. inflata* 96—100 % left coiling, *Globorotalia scitula* 97—100 % right coiling. In all cases the coiling direction is given for 100 specimens except for *G. scitula* where 50 specimens are used. The coiling direction of *Globorotalia truncatulinoides* shows many fluctuations in the cores. Unfortunately this species is frequently absent so that continuous curves cannot be made. The species is almost entirely absent in the eastern Mediterranean surface sediments but in the western area the coiling direction shifts from 79 % left coiling near Gibraltar to 99 % at about Longitude 0°. High ratios of left coiling (88 %+) are maintained eastward to Sta. 4711 where 62 % is found (Parker, 1955). Eastward from this station there are too few specimens for analysis. The core data suggest that the left-coiling province indicated in the western area is maintained in the eastern since samples at, or near, the »tops» contain specimens indicating left-coiling dominance. Starting at the top of the cores, left coiling is dominant until a point just above the cold faunal optimum of the uppermost cold interval where there is a shift to right-coiling dominance. Ericson, Wollin, and Wollin (1954) made similar observations in North Atlantic cores taken where left coiling of *Globorotalia truncatulinoides* is dominant in modern faunas. Below this shift to right coiling in eastern Mediterranean cores occurrences of the species are sparse almost to the bottom of the lower long cold period but show several coiling-direction fluctuations. In the lower part of this cold period and in the long warm interval below occurrences are much more frequent and show many fluctuations. These occur often but by no means invariably at the same times as faunal shifts probably caused by climatic changes.

Discussion

In the cores the planktonic faunas reflecting changing climates show changes from what may be called the modern cool-temperate fauna (*vide* Parker, 1955) to a cooler one indicative of glacial times and, in some cases, to a warmer one indicative of warmer-than-present-day climates. Emiliani (1955 b) gives temperature ranges from 7.9—27° C calculated from oxygen isotope analyses of »*Globigerinoides rubra* (rounded form)» in Core 189. Analyses of other species in the core give simultaneously

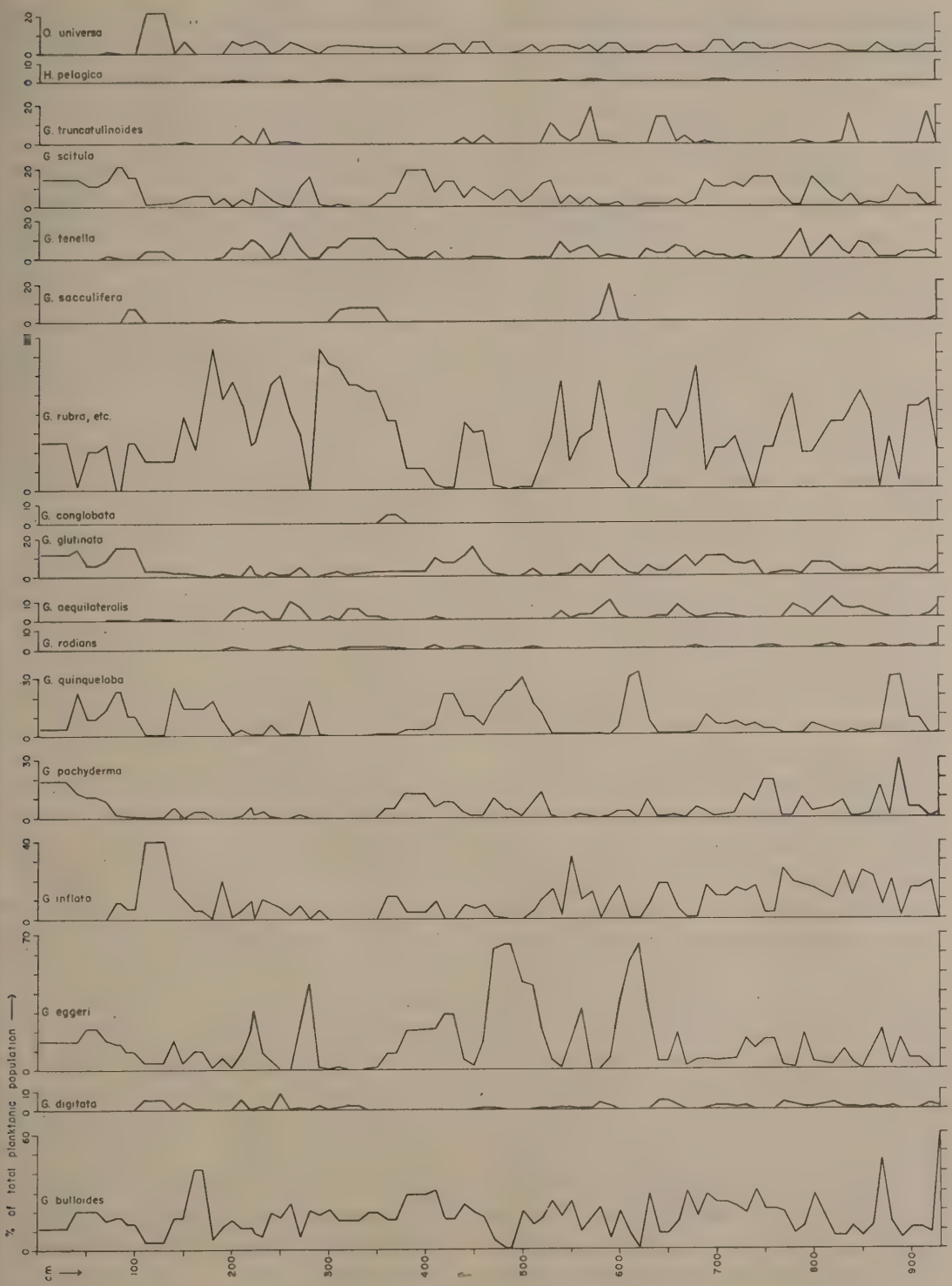
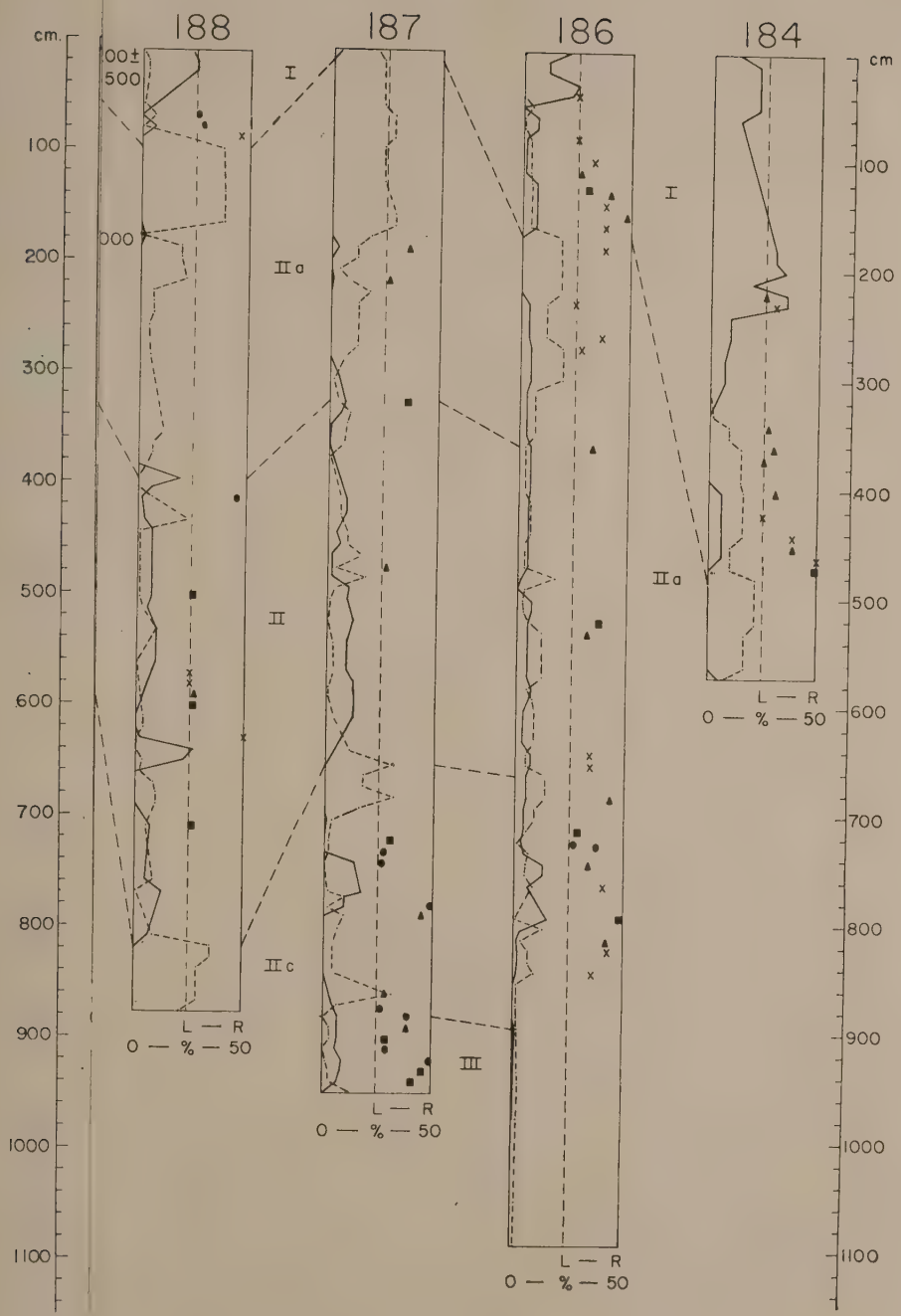


Figure 5. Frequency curves of planktonic species in Core 190.

different results although they show the same fluctuations. The maximum temperature calculated (»*G. rubra* (tapered form)») was 32.8° C, the minimum (»*Globigerina dubia*») 6.9° C. Emiliani postulates that *G. rubra* (rounded and tapered), which indicates the highest temperatures, secretes its calcium carbonate test near the surface where temperatures are expected to be higher as opposed to the deeper habit of other species indicating simultaneously lower temperatures. In addition, he says that in a sea like the Mediterranean where seasonal variation of temperature occurs »the isotopic temperatures commonly represent values close to the summer mean, because summer is apparently the season during which most of the carbonate deposition takes place.» (*op. cit.*, p. 88). This supposition seems rather odd in view of the 7.9—27.0° C range calculated for the rounded form of »*G. rubra*». In modern times high temperatures analogous to his maximum calculated temperature of 32.8° C are found in the Persian Gulf, but this is a shallow sea whose average depth is only 25 m., maximum depth 90 m. (Sverdrup, Johnson, and Fleming, 1942). A mean summer temperature of this magnitude for the surface layer at localities similar to those from which the cores were taken would reflect far warmer conditions than any to be found in modern times, even in the warmest regions, in oceans of comparable depths. Zooxanthellae are known to exchange oxygen with calcium-carbonate-forming organisms (Emiliani, 1955 a, p. 544). That Zooxanthellae or »yellow cells» occur in foraminiferal tests has been reported by Murray (1897) in *Globigerina bulloides* and *Globigerinella aequilateralis* and by Rhumbler (1900) in *Orbulina* and *Globigerina*, specifically *G. bulloides*. It is very likely that they are to be found in other planktonic species as well. For this reason, and in view of the unusually high temperatures registered by »*G. rubra*», temperatures calculated from oxygen isotope analyses of planktonic Foraminifera should be viewed with caution. As mentioned previously, the temperature fluctuations registered by these isotopic temperature studies are in agreement with those shown by the planktonic population studies.

Emiliani (1955 b) suggests a time sequence for Core 189 which extends back to the Gunz/Mindel interglacial period, giving an approximate date for the level at 720 cm., which he correlates with the Mindel glaciation, of 200000 years B. P. This figure is much lower than that of workers such as Kay (1931), Zeuner (1952), Penck and Bruckner (1909), Ericson and Wollin (1956 b) and others for the same event. It is believed that a more realistic picture can be obtained by placing the beginning of the Last Glaciation at the 510 cm. level (approximate) in Core 189. The cold oscillation from 569.5—649.5 cm. would then represent that of the Last Interglacial (*vide* Zeuner, 1952) and the temperature minimum at 790—800 cm. might possibly represent the final part of the Penultimate Glaciation although it is of comparatively short duration and might represent another cold oscillation of the interglacial period. Both of these oscillations are much shorter than the two long cold intervals which occur in the upper part of the core and, therefore, do not appear to be of sufficient duration to represent glacial periods of the magnitude of the Riss or Mindel. On the other hand, if both the upper cold intervals were considered to represent glacial periods (Würm and Riss) the long warm interval below is proportionally much too long to represent a normal interglacial period (Riss/Mindel) in view of the much smaller length of the warm interval between the upper cold intervals. A comparison of the postulated time scale and the numbering system used with those of Emiliani (1955 b) is shown in Figure 2.

Figure 6 gives the correlation between cores of the cold and warm intervals reflected by the faunas, using the interval numbers


188
187
186
184
cm.
cm
100
200
300
400
500
600
700
800
900
1000
1100
I
IIa
II
IIc
III
L — R
0 — % — 50

shown in Figure 2. These correlations agree in most cases with those made by other workers using other criteria. Between Cores 189 and 190 Kullenberg (1952) makes correlations based on various sediment bands which confirm those made here. His correlations based on the planktonic foraminiferal faunas are also in agreement although his interpretations of the faunas differ somewhat. Mellis (1954) has correlated two sets of ash bands in various cores. These, too, confirm the present ones with the exception of the upper ash bands in Cores 187 (39—40.5 cm.) and 188 (146.5—151 cm.). In the present study these bands appear to correlate but do not correlate with the upper bands in Cores 189 (0—2 cm.) and 192 (0—4 cm.), which are also apparently correlative in the present scheme. In Cores 187 and 188 the upper bands are very close to the lower ones, both being in the upper cold interval. In Cores 189 and 192 they are near the top, widely separated from the lower ones, and occur above the cold interval in what is interpreted to be postglacial time.

The planktonic faunas at 219.5 cm. in Core 184 and 29.5 cm. in Core 186 appear to reflect a climate warmer than that of the present day with frequencies for the »warm» fauna of 25—35.5 % as opposed to modern ones of mostly less than 20 % (*vide* Figures 3, 6). It is suggested that these faunas may reflect the so-called »Climatic Optimum» of *ca.* 5000 years B. P. (Flint, 1947, and others). There is slight evidence of similar conditions at 9.5 cm. in Core 194 and at the top of Core 188. These ultra-warm faunas correlate and their relative positions in Cores 184 and 186 are reasonable in view of the positions of the core stations in respect to the Nile Delta. Core 184 shows a far longer section reflecting postglacial warming than does Core 186 as is to be expected since it was taken nearer the delta.

Faunal evidence suggests that the final maximum of the Last Glaciation is reflected at 479.5 cm. in Core 184 and 169.5 cm. in Core 186. This evidence lies not only in the high frequency of the »cold» fauna but also in the fact that these sections precede (geologically) by a evry short distance the shift from right- to left-coiling dominance of *Globorotalia truncatulinoides* believed to have taken place soon after the Last Glaciation, as has been previously discussed. In Core 189 the position of this maximum appears to be at 10 cm. The section from 10—20 cm. is that for which Rubin and Suess (1955) give a radiocarbon date of 17200 ± 500 years B. P. Assuming that this point can be correlated with that at 479.5—489.5 cm. in Core 184, a sedimentation rate can be calculated for the section from 219.5 cm. to 490 cm. This rate is 22.1 cm./1000 years which seems a reasonable one. Making the same assumption for the section at 169.5—179.5 cm. in Core 186, the sedimentation rate for this core between 29.5 cm. and 179.5 cm. is 12.2 cm./1000 years. We hope to check these dates by radiocarbon dating of material from these cores in the near future.

A similar series of calculations for Core 194 gives a sedimentation rate of 5.7 cm./1000 years. Extrapolating this rate to the bottom of the core, postulated to reflect a time close to the beginning of the Würm glaciation, we obtain a date for that event of 130000 years B. P., which is a rather large figure. The presence of displaced material in this core, however, suggests that a uniform sedimentation rate cannot be assumed. Further evidence of this is the frequent alternation of samples containing few or no planktonic Foraminifera with those containing large numbers. The assumption of uniform sedimentation in such a relatively small sea seems very dangerous but if it is understood that the calculated rates are high speculative they may be suggestive.

If we assume a date of 80000 years B. P. for the beginning of the Last Glaciation and 40000 years B. P. for the beginning of the final part (Würm II, III) of the Last Glaciation (Suess, 1956) additional sedimentation rates

TABLE 5. Estimated sedimentation rates in cm./1000 years.

Core no.	199	198	197	196	195	194	192	189*	188	187	186	184
Years B. P. 5000[1])—17200±500[2])						5.7			6.7		12.2	22.1
5000—40000[3])						10.8			11.1		9.4	
5000—80000[4])											11.4	
17200—40000	18.6	19.7	10.5	13.5	11.4	13.8	15.7	10.5	12.8	13.1	7.9	
17200—80000		15.1			10.7		11.3	8.6		13.5	11.3	

may be calculated using the geological interpretation of the cores made on the basis of the planktonic faunas (*vide* Figures 2, 6). Table 5 gives these for some of the cores. The rates are highest for Cores 184, 198, and 199 and lowest for Cores 189 and 197.

Appendix A: Core Descriptions

In the core descriptions the following terminology will be used for the sake of brevity:

»warm fauna» — consists of *Globigerinella aequilateralis*, *Globigerinoides rubra* s. s. (10 % of *G. rubra*, etc., when present), *G. sacculifera*, *Hastigerina pelagica*.

»cold fauna» — consists of *Globigerina pachyderma* and *Globorotalia scitula*

I — post-glacial warm period to modern times

II a — last phases of the Last Glaciation (Würm II, III) (Stages 2—4 of Emiliani, 1955 b)

II b — interstadial of the Last Glaciation (Würm I/II—III) (Stage 5 of Emiliani, 1955 b)

II c — first phase of the Last Glaciation (Würm I) (Stage 6 of Emiliani, 1955 b)

III — Last Interglacial (Riss/Würm) (Stages 7—11+ of Emiliani, 1955 b)

IV — Penultimate Glaciation (Riss)

The benthonic species listed as single-species occurrences at the end of each core description are omitted from the data tables. The numbers in parentheses following the names indicate the core samples in which the specimens were found.

Core 184

Length sampled 570 cm.; depth 1176 m.; population counts given in Table 6.

The planktonic fauna at the top is comparable to that of the present day. This continues below to 60 cm. From 60—170 cm. there are few Foraminifera consisting mostly of *Globigerinoides rubra*, etc., a probable indication of rapid sedimentation. Below 170 cm. the faunas reflect warmer-than-present-day temperatures reaching a maximum at 219.5—30 cm. where the »Climatic Optimum» of ± 5000 years B. P. is postulated. Below this point the warm fauna decreases with a corresponding increase of the cold fauna to 479.5 cm., the top of Ia. Ia extends to the bottom sample which reflects the beginning of a warm oscillation.

*) Rate calculated by Emiliani (1955 b) for Core 189, 4.3 cm./1000 years.
[1]) »Climatic Optimum».
[2]) Radiocarbon date in Core 189 (10—20 cm. from top).
[3]) Estimated time of beginning of Würm II, III glaciation.
[4]) Estimated time of beginning of Last Glaciation.

Isolated samples throughout the core in addition to the section from 60—170 cm. contain few or no Foraminifera. *Globorotalia truncatulinoides*, never very common, shows left-coiling dominance down to 459.5 cm. where there is a shift to right-coiling dominance just above the top of Ia. This is maintained to 469.5 cm. below which the species is absent.

Down to 199.5 cm. the benthonic populations are small — less than 60 specimens. Below 210 cm., except at 239.5 cm., they are between 106 and 268 specimens. There is some evidence of the presence of displaced specimens below 279.5 cm., although this is not conclusive. The presence of such species as *Elphidium* spp., *Gyroidina umbonata*, *Pullenia quinqueloba*, and *Spirillina vivipara* is suggestive of displacement but, because of the comparatively shallow depth from which the core was taken, may not be indicative.

The following single-specimen occurrences have been omitted from Table 6: *Eggerella bradyi* (49), *Elphidium advena* (49), *Neoconorbina williamsoni* (49, 54), *Patellina corrugata* (35), *Pullenia* cf. *P. riveroi* (35), *Pyrgo lucernula* (35), *Spiroloculina canaliculata* (29), *Spirophthalmidium acutimargo* (49), and *Streblus beccarii* var. (37).

Core 186

Length sampled 1090 cm.; depth 2025 m.; population counts given in Table 7.

The warm fauna at the top is comparable to that of the modern fauna. This increases to a maximum, after a slight decrease, at 30 cm. where the »Climatic Optimum» is postulated to have occurred. Below this point the warm fauna decreases with a corresponding increase in the cold fauna to a maximum at 169.5 cm. the top of IIa. The cold fauna persists below, with some fluctuations and a general decrease, to 359.5 cm., the top of IIb. IIb extends from 359.5—659.5 cm. with three small warm maxima at 499.5—510 cm., 579.5 cm., and 639.5—50 cm., the top of IIc. IIc shows two cold maxima[1]) at 659.5 cm. and 799.5 cm. and extends to 889.5 cm. III extends below to the bottom. The upper boundary of III is very hypothetical since below this point the warm and cold faunas are not well developed. There are few or no Foraminifera from 769.5—80 cm. and below 950 cm., except at 1050 cm., 1069.5 cm., and 1089.5 cm. Occasional isolated samples, in addition, are barren. Very high frequencies of *Globigerina eggeri* occur at 849.5—70 cm. and 972 cm. *Globorotalia truncatulinoides* shows left-coiling dominance down to 149.5 cm. where right-coiling dominance occurs. Below this point occurrences are few and the frequencies are low but the trend is towards left coiling with minor fluctuations to 679.5 cm. where again right coiling is dominant. Below this point there are several fluctuations and a somewhat stronger occurrence to 839.5 cm. below which the species is absent.

The benthonic Foraminifera are comparatively rare, only once exceeding 100 in a sample. They are especially rare from the top to 50 cm. (1—11 specimens), at 759.5 cm. (4 specimens) and from 849.5 cm. to the bottom (0—6 specimens). Displaced specimens occur at 729.5 cm. and possibly 789.5 cm. as shown by the presence of such species as *Asterigerinata mamilla*, *Hanzawaia rhodiensis*, and *Elphidium* cf. *E. minimum*. Several species with a deeper habitat also appear to be displaced though this cannot be definitely established. Among these are *Bulimina gibba*, *Hyalinea balthica*, and *Nonion barleeanum*.

The following single-specimen occurrences have been omitted from Table 7: *Asterigarinata mamilla* (74), *Bolivina pseudoplicata* (32), *Bulimina gibba* (74), *Elphidium* cf. *E. minimum* (74, 80), *Glomospira charoides* (1), *Loxostomum alatum* (4), *Nonion barleeanum*, etc. (13, 24),

[1]) The term »cold maximum» is used advisedly since it refers to the maximum frequency of the cold fauna rather than directly to the temperature, although the former is believed to reflect the latter.

Pullenia bulloides (6), *Pyrgoella sphaera* (13), *Sigmoilina tenuis* (60, 73), and *Spirophthalmidium acutimargo* (49).

Core 187

Length sampled 950 cm.; depth 2500 m.; population counts given in Table 8.

The fauna at the top of the core is cooler than the modern one but a trace of the warm fauna is present. At 9.5 cm. the warm fauna has disappeared and the cold fauna increased; the top of IIa is tentatively placed at this point. Below the cold fauna persists, showing two maxima at 149.5 cm. and 219.5 cm., to 319.5 cm., the top of IIb. IIb shows roughly three warm maxima at 319.5 cm., 409.5—23.5 cm., and 577.5 cm. It extends to 649.5 cm. IIc has approximately two cold maxima at 649.5—79.5cm. and 809.5 cm. The top of III is at 879.5 cm. and continues, with one warm maximum at 915.5 cm., to the bottom sample where cooler conditions prevail, probably indicating a cool phase of III. Numerous isolated samples throughout contain few or no Foraminifera. Very high frequencies of *Globigerina eggeri* occur from 800.5—14 cm. *Globorotalia truncatulinoides* is found rarely, showing left-coiling dominance to a depth of 779.5 cm. where right-coiling dominance occurs. Below 869.5 cm. the species is more common and the coiling dominance fluctuates rapidly.

With one exception the benthonic population ranges from 0—50 specimens with the highest populations usually occurring in the colder periods; at 459.5 cm. 91 specimens occur of which 77 are *Articulina tubulosa* and variants. There is slight evidence of the presence of displaced specimens at 449.5 cm. and 479.5 cm. shown by the presence of such species as *Asterigerinata mamilla*, *Nonionella turgida*, and *Rosalina obtusa*.

The following single-specimen occurrences have been omitted from Table 8: *Asterigerinata mamilla* (47), *Bolivina pseudoplicata* (46, 51), *B. subaenariensis* (23), *Cassidulina* cf. *C. oblonga* (38), *Epistominella rugosa convexa* (42, 48), *Gavelinopsis praegeri*, etc. (47), *Glomospira charoides* (18), *Hyalinea balthica* (47), *Nonionella turgida* (51), *Patellina corrugata* (7, 51), *Rosalina obtusa* (51), *Rotamorphina? involuta* (51), and *Virgulina mexicana* (69, 96).

Due to a damaged sieve, a part of the population may have been lost in the following samples: 35, 46, 69, 70, 73, 74, 77.

Core 188

Length sampled 880 cm.; depth 2810 cm.; population counts given in Table 9.

The top sample contains a warm fauna of somewhat higher frequency than the modern one, which increases with depth to a maximum at 9.5—20 cm., the postulated »Climatic Optimum». Below this point the warm fauna decreases and the cold fauna increases, with one minor oscillation, to a maximum at 89.5 cm., the top of IIa. Cold faunas persist to 392 cm., showing three maxima at 89.5—158 cm., 209.5 cm. and 349.5 cm. IIb extends from 392 cm. to 819.5 cm. with three warm maxima at 392 cm., 639.5 cm., and 719.5 cm. IIc extends from 819.5 cm. to the bottom with the cold fauna at high frequencies throughout. Many isolated samples are barren of Foraminifera. More extended barren sections occur from 289.5—340 cm., 469.5—90 cm., 539.5—50 cm., and 779.5—800 cm. In some cases there appears to be marked solution of the calcium carbonate tests, especially at 489.5 cm. and 539.5 cm. *Globigerina eggeri* does not occur at high frequencies. *Globorotalia truncatulinoides* occurs with left-coiling predominance at 59.5—70 cm.; at 79.5 cm. a few specimens occur showing right-coiling dominance. No specimens occur below this point to a depth of 409.5 cm. where right coiling is again dominant. At 499.5 cm. left-coiling dominance occurs and persists with several occurrences to 629.5 cm. where a few specimens show right-coiling dominance. One

occurrence at 709.5 cm. shows left-coiling dominance; below this point there are no more specimens. The core does not penetrate the zone of abundant occurrence of *G. truncatulinoides* found in many of the cores in the lower part of IIc and III.

Less than 50 benthonic specimens occur in all samples studied with two exceptions. One sample, at 379.5 cm., contains 153 specimens of which 142 are *Articulina tubulosa* and variants. The second is a displaced fauna containing 1981 specimens. This fauna includes such shallow water species as *Rosalina* aff. *R. columbiensis*, *Streblus beccarii* and variants, and various species of *Elphidium*. In addition, many relatively deep species are abundant. The most common of these are: *Bolivina albatrossi*, *B. dilitata dilitatissima*, *Bulimina costata*, *B. marginata*, and *Hyalinea balthica*. The samples above and below this one (not listed in Table 9) do not contain this fauna. In general, benthonic specimens are more common in the cold periods than the warm ones.

The following single-specimen occurences have been omitted from Table 9: *Bolivina catanensis* (73), *B. subaenariensis* (19), *Bulimina aculeata* (1), *Cibicides* aff. *C. floridanus* (20), *Elphidium complanatum* (73), *E.* cf. *E. minimum* (73), *E. pulvereum* (73), *Globobulimina pseudospinescens* (73), *Neoconorbina williamsoni* (73), *Nonion* sp. B (73), *Nonionella turgida* (73), *Patellina corrugata* (73), *Pullenia* cf. *P. riveroi* (73), *Pyrgoella sphaera* (9), and *Reusella spinosissima* (73).

Core 189

Length sampled 840 cm.; depth 2664 m.; population counts given in Table 10.

The planktonic fauna at the top is comparable to the modern one. The cold fauna increases below to a maximum at 9.5 cm., the top of IIa. The section from 10—20 cm. has been dated by Rubin and Suess (1955), using radiocarbon measurements, at 17200 ± 500 years B. P. The cold faunas of IIa predominate to a depth of 209.5 cm. with two strong and one weak cold maxima at 59.5—90 cm., 159.5—80 cm., and 218 cm. The section from 170—80 cm. was radiocarbon-dated by Rubin and Suess as older than 32000 years B. P. IIb extends from 209.5 cm. to 359.5 cm. with three warm maxima at 259.5 cm., 319.5 cm., and 350.5 cm. The cold faunas of IIc extend from 359.5 cm. to 509.5 cm. with one strong and two minor cold maxima at 369.5—400 cm., 449.5 cm., and 489.5 cm. III extends from 509.5 cm. to the bottom. The cold maximum at 789.5 cm. appears to be of comparatively short duration and probably is a cold oscillation of III although there is a possibility that it may be the final cold oscillation of IV. Above this cold oscillation, III shows several small cold oscillations, with one stronger one between 579.5—608 cm. Below 799.5 cm. warm faunas prevail to the bottom sample where there is a decrease with a related increase in the cold fauna. The organic-rich layers described by Kullenberg (1952, p. 16) occur in both cold and warm periods. Only one sample, at 497.5 cm., contains too few planktonic specimens for analysis. *Globigerina eggeri* occurs at very high frequencies at 281.5 cm., 429.5 cm., 469.5 cm., and 527.5 cm., apparently more closely related to cooler periods although this is not true of the occurrence at 469.5 cm. *Globorotalia truncatulinoides* does not occur in the upper part of the core but shows right-coiling dominance in scattered samples from 209.5—419.5 cm. Below this point in IIc the occurrences are stronger and the coiling dominance fluctuates frequently to the bottom.

The benthonic population totals less than 50 specimens with the following exeptions: 169.5—90 cm., 429.5 cm., 449.5 cm., 532.5 cm., 629.5 cm., 699.5 cm., and 779.5—90 cm. The cold fauna predominates in all the above sections At 699.5 cm., 1280 specimens of *Bulimina aculeata* occur; at 779.5 cm., 896 specimens. A single occurence of *Nonionella turgida* at

789.5 cm. is the only indication of displacement of shallow species into the core.

The following single-specimen occurrences have been omitted from Table 10: *Nonionella turgida* (86), *Patellina corrugata* (63), and *Uvigergina mediterranea* (45).

Core 190

Length sampled 930 cm.; depth 2900 m.; population counts given in Table 11.

The fauna at the top contains a high percentage of the cold fauna and appears to be below the top of IIa. IIa extends to 259.5 cm. with two cold maxima at 1—30 cm. and 39.5—70 cm., the lower one being of much lower frequency than the upper, as in all the cores. IIb extends from 259.5—379.5 cm. with two warm maxima at 259.5 cm. and 339.5—50 cm., the latter roughly corresponding to two maxima (319.5 cm., 350.5 cm.) in Core 189. IIc extends from 379.5—589.5 cm., showing several fluctuations but with three major cold ones at 379.5—400 cm., 418.5—29.5 cm., and 579.5 cm. III extends from 590 cm. to the bottom. There are two moderately large cold maxima at 749.5 cm. and 889.5 cm. but many minor oscillations may be resolved into four warm maxima at 589.5 cm., 659.5 cm., 779.5 cm., and 819.5 cm., the last two being closely linked. From 609—620 cm. a white streak was observed in the dark sediment of the core. The material of this white streak (Table 11, 65 B, 66 B) contains a warm fauna similar to that found in the section above from 560—600 cm. and probably derived from it. A crack in the sediment was probably filled by subsequent deposition. Only one sample, at 487 cm., contains too few Foraminifera for analysis. Very high frequencies of *Globigerina eggeri* occur at 469.5—83 cm., 609.5 cm., and 619.5 cm., all sections where the cold fauna predominates. *Globorotalia truncatulinoides* occurs from 210—60 cm. showing several fluctuations of right- and left-coiling dominance. From 439.5 cm. (in IIc) to 920 cm. (in III) the species is relatively abundant (except from 669—832 cm.) with two reversals in coiling direction in IIc and seven and a half reversals in III.

There are less than 50 benthonic specimens in all the samples analyzed with the following exceptions: 49.5 cm., 139.5 cm., 161.5—90 cm., 469.5 cm., 510.5 cm., 659.5 cm., and 869.5 cm. At all these levels, except 659.5 cm., the cold fauna is predominant. At 869.5 cm. the population is large, 768 specimens of *Bulimina aculeata* forming the major part. This occurrence may correlate with the lower abundant occurrence at 779.5 cm. in Core 189. There is very slight evidence of displacement from shallow water at 39.5 cm. and 109.5 cm. in single-specimen occurrences of *Nonionella turgida* and *Elphidium pulvereum* respectively.

The following single-specimen occurrences have been omitted from Table 11: *Astrononion stelligerum* (52), *Bolivina dilitata dilitatissima* (17), *B. pseudoplicata* (6), *Elphidium pulvereum* (13), *Gavelinopsis praegeri*, etc. (48, 55), *Globobulimina* ? sp. (40, 51), *Glomospira charoides* (6), *Neoconorbina williamsoni* (42, 68), *Nonionella turgida* (5), *Spirophthalmidium acutimargo* (18, 55), and *Virgulina mexicana* (70, 72).

Core 191

Length sampled 367.5 cm.; depth 3635 m.; population counts given in Table 12.

This core cannot be firmly correlated with adjacent ones (190, 192). The bottom profile given by Koczy (1956, profile 16) shows that this core was taken in a deep depression of the sea floor into which sediment may often be displaced by slumping. The presence of displaced species in various parts of the core shows that material has been carried here from relatively shallow depths. In Core 191 this material appears to have caused more disturbance of the normal sequence than usually happens, even when displaced Foraminifera are present. The sequence of warm and cold planktonic faunas

does not follow the usual pattern observed in most of the other cores and for that reason no attempt has been made to interpret the geologic age of the cold and warm periods.

Both warm and cold faunas are present at the top of the core. The cold fauna increases rapidly with depth reaching a first maximum at 25.5 cm. and a somewhat higher one at 76.5—87 cm. Below this point the cold fauna declines rapidly and the warm fauna increases to a maximum at 139.5 cm. after which it, too, declines rapidly. The cold fauna then increases gradually to a maximum at 219.5—30 cm., decreasing gradually below. The warm fauna has a short period of predominance reaching a maximum at 350.5—53.5 cm. below which it declines and the cold fauna predominates increasingly to the bottom. Only one sample at 299.5 cm. contains too few planktonic specimens for analysis. *Globigerina eggeri* occurs at a very high frequency at 145.5 cm. *Globorotalia truncatulinoides* shows left-coiling dominance at the top, right-coiling dominance at 68.5 cm. (few specimens), and left coiling again at 96.5 cm. Several occurrences below show a gradual shift to maximum right-coiling dominance at 154.5 cm. Below this point the species occurs only once at 289.5 cm. with no definitive coiling direction.

No sample studied contains more than 62 benthonic specimens. Usually there are fewer. There is evidence of displacement of shallow species at 106.5 cm. and in most samples between 154.5—310 cm. based on various species of *Elphidium*, *Rosalina*, *Cibicides lobatulus*, etc.

The following single-specimen occurrences have been omitted from Table 12: *Bolivina albatrossi* (5, 14), *B. attica* (41), *Bulimina exilis* (10), *B. gibba* (40), *Cassidulina* cf. *C. sicula* (29), *Cassidulinoides tenuis* (10, 18), *Chilostomella mediterranensis* (3), *Cibicides lobatulus* (26, 32), *Eggerella bradyi* (11), *Elphidium advena* (34), *E. pulvereum* (19, 30), *Gyroidina* cf. *G. neosoldanii* (28, 33), *Hanzawaia rhodiensis* (14), *Neoconorbina terquemi* (26, 33), *Nonion* sp. A (33, 36), *Nonionella turgida* (33), *Patellina corrugata* (14, 34), *Planulina ariminensis* (2), *Pullenia quinqueloba* (34, 36), *Robulus* sp. (3), *Uvigerina auberiana* (14, 36), and *U. peregrina* (33).

Core 192

Length sampled 859 cm.; depth 2680 m.; population counts given in Table 13.

The fauna at the top is comparable to that of the present day. The cold fauna increases rapidly with depth to a maximum at 89.5 cm., the top of IIa. IIa extends to 458.5 cm., divided into two parts with maxima at 89.5 cm. and 379.5 cm. The former lessens gradually with minor fluctuations to 299.5 cm. and thus forms the major part of IIa. IIb extends from 458.5—620 cm. with warm maxima at 503 cm., 549.5—59.5 cm. and *ca.* 609.5 cm. IIc extends from 619.5—822 cm. with two cold maxima at 619.5—30 cm. and 779.5 cm., and a smaller cold oscillation at 719.5—30 cm. The top of III is placed tentatively at 822 cm. although the warm fauna below is not well-developed. This interpretation is based on comparison with adjacent cores (191, 193). No samples are barren of planktonic specimens. *Globigerina eggeri* does not occur at high frequencies. *Globorotalia truncatulinoides* shows right-coiling dominance at 14.5 cm., left coiling at 379.5 cm., right coiling at 397 cm., and left coiling at 488.5 cm. Below 759.5 cm. it occurs in several samples and shows several coiling-dominance fluctuations, mainly, however, left-coiling.

The benthonic population is usually less than 100 specimens with the following exceptions: 271.5 cm., 309.5—80 cm., 619.5 cm., 659.5—720 cm., 749.5 cm., 771—80 cm., and 801.5 cm. In all these samples the cold planktonic fauna predominates. There are 146 specimens of *Articulina tubulosa* and variants at 759.5 cm. There is evidence of displacement of benthonic specimens from shallow water throughout most of the core as shown by the presence of *Bolivina difformis*, *Cibicides lobatulus*, *Elphidium* spp.,

and *Rosalina* spp., etc. This displacement is easily explained by the proximity of the Island of Crete.

The following single-specimen occurrences have been omitted from Table 13: *Elphidium crispum* (38), *E. granosum* (77, 85), *P. verriculata* (76, 85), *Glomospira* cf. *G. gordialis* (1), *Lagenondosaria scalaris* (41, 79), *Planulina ariminensis* (41, 76), *Pullenia bulloides* (41, 85), *Rosalina suezensis* (26, 37), *Sphaeroidina bulloides* (41), *Streblus beccarii* var. (37), and *Textularia sagittula* (39, 69).

Core 193

Length sampled 622 cm.; depth 2130 m.; population counts given in Table 14.

In Figure 6 this core has not been correlated with adjacent ones nor has any age been assigned to the warm and cold periods reflected by the planktonic faunas. The character of these faunas and the presence of abundant occurrences of *Globorotalia truncatulinoides* in the upper two-thirds of the core point to the possibility that this section is comparable to the lower sections of some of the other cores, and that several meters may be missing from the top. If the top is correlated with the 350 cm. depth in Core 190 a reasonably good correlation can be made. Prof. Kullenberg (personal communication) says, however, that he is of the opinion that the loss from the top of the cores does not exceed one meter. According to the bottom profile given by Koczy (1956, profile 16) the core was taken on a topographic high and there is a possibility that material has slumped or been washed off by bottom currents leaving a lower section exposed.

The warm fauna is present to a greater or lesser extent almost throughout the core. The cold fauna predominates in the following sections: 9.5—190 cm., 229.5—92 cm., 309.5 cm., 329.5—60 cm., 389.5—409.5 cm., 429.5—90 cm., 519.5—60 cm., 579.5—600 cm., and in the bottom sample. The only indication of a major cold period, however, is from 9.5—200 cm. High frequencies of *Globigerina eggeri* occur at 339.5 cm. and 549.5 cm. *Globorotalia truncatulinoides* is present frequently to a depth of 410 cm., showing about nine shifts in coiling-direction dominance.

The benthonic populations are less than 100 specimens with the following exceptions: 79.5—120 cm., 149.5 cm., 229.5 cm., 309.5 cm., 339.5—50 cm., and 529.5—50 cm. In all the above sections the cold fauna is predominant. There are 278 specimens of *Bulimina aculeata* at 309.5 cm. This occurrence together with the high frequency occurrences of *Globigerina eggeri* are added evidence for the correlation of this core with the lower sections of adjacent ones. *Pyrgo serrata* is found in this core only, in four samples with an occurrence of 94 specimens at 339.5 cm. A few obviously displaced shallow specimens are scattered throughout but the displaced population is a minor constituent of the total benthonic population.

The following single-specimen occurrences have been omitted from Table 14: *Angulogerina angulosa* (11, 37), *Bolivina difformis* (57), *Cassidulina subglobosa* (8, 51), *Elphidium complanatum* (46), *E.* spp. (29, 57), *Globobulimina pseudospinescens* (51, 55), *Gyroidina altiformis* (2, 62), *Hanzawaia rhodiensis* (40), *Hyalinea balthica* (60), *Loxostomum alatum* (17), *Neoconorbina terquemi* (40, 41), *Nonion* sp. A (8, 64), *Patellina corrugata* (17, 36), *Planorbulina mediterranensis* (36), *Rosalina obtusa* (24, 26), *Siphotextularia concava* (17), *Uvigerina peregrina* (36, 45), and *Wiesnerella auriculata* (10).

Core 194

Length sampled 718.5 cm.; depth 3000 m.; population counts given in Table 15.

Both warm and cold faunas are present in the »top» sample at 2 cm. The warm fauna increases below to a maximum at 9.5 cm. This point is tentatively interpreted as representing the time of the »Climatic Optimum». The warm fauna decreases below and at 59.5 cm. the cold fauna appears at a high frequency. The top

of Ia is at 69.5 cm. and extends to 389.5 cm., with two maxima at 149.5 cm. and 329.5 cm. IIb extends to 549.5 cm. and has two warm maxima at 389.5 cm. and 459.5 cm. with some additional minor fluctuations. IIc extends to the bottom but there are indications that the top of III is imminent. IIc has three cold maxima at 559.5—79.5 cm., 619.5 cm., and 679.5—83 cm. Most samples contain planktonic Foraminifera. *Globigerina eggeri* occurs at high frequencies at 424 cm. and 659.5 cm. Occurrences of *Globorotalia truncatulinoides* are rare, scattered throughout the core, and show mostly left-coiling dominance.

The benthonic population is less than 100 specimens with the following exceptions: 69.5 cm., 149.5—220 cm., 299.5—330 cm., 479.5—97.5 cm., 529.5 cm., 589.5—610.5 cm., 629.5—50 cm., and 692.7 cm. In all but the last section the cold fauna predominates. Displaced shallow specimens occur in most of the samples but are especially common from 69.5—330 cm. and 479.5—650 cm. Various species of *Elphidium* and *Rosalina* are common as well as many other shallow species. These comprise the major parts of the faunas in the cold periods IIa and IIc showing that not only are there more specimens of indigenous species in some parts of the cold-period sections but also more displaced specimens.

The following single-specimen occurrences have been omitted from Table 15: *Biloculinella labiata* (24), *Cibicides kullenbergi* (56, 74), *Elphidium complanatum* (33, 64), *E.* cf. *E. minimum* (25, 62), *Lenticulina peregrina* (31, 53), *Planulina ariminensis* (33), *Reussella spinosissima* (52, 56), *Rotamorphina? involuta* (66), *Siphonina reticulata* (56), *Siphotextularia concava* (31), *Spirillina wrightii* (56), *Textularia conica* (13), and *T. sagittula* (27).

Core 195

Length sampled 930 cm.; depth 3665 m.; population counts given in Table 16.

In the top sample the warm fauna is slightly predominant but neither cold nor warm fauna is well-developed. The cold fauna increases to a maximum at 9.5 cm., the top of IIa. Other cold maxima in IIa are at 109.5—20 cm., 229.5 cm., and 269.5 cm. These maxima resolve into two main divisions, the lower one, as in the other cores, being much smaller and shorter. IIb extends from 279.5—449.5 cm. with three warm maxima at 309.5—20 cm., 359.5 cm., and 379.5 cm. IIc extends from 450—759.5 cm. with several fluctuations, the chief maxima being at 449.5 cm., 539.5—50 cm., 659.5—70 cm., and 729.5 cm. III probably extends to the bottom although there is a fairly large cold fluctuation at the bottom of the core. III has two warm maxima at 759.5 cm. and 849.5—60.5 cm. Only four samples scattered throughout the core contain few or no planktonic specimens. *Globigerina eggeri* occurs at very high frequencies at 340.5 cm., 618.5—50 cm., and 779.5—800 cm. *Globorotalia truncatulinoides* occurs at the top with left-coiling dominance; at 299.5 cm. and 599.5 cm. right-coiling dominance is found. At 679.5 cm. and below the species is much more abundant than above, starting with left-coiling dominance and showing three coiling reverses below to 850 cm. Downward from this point it is absent.

The benthonic populations are less than 100 specimens except at the following depths: 129.5 cm., 259.5 cm., and 609.5 cm.; in all cases the cold fauna is predominant. At 259.5 cm. there are 106 specimens of *Articulina tubulosa* and variants; at 609.5 cm. there are 146 specimens. Displaced specimens occur throughout the core except at the following depths: 259.5 cm., 329.5—50 cm., 389.5—420 cm., 468.5 cm., 649.5 cm., 689.5 cm., 719.5 cm., 739.5—50 cm., 769.5 cm., 849.5—60.5 cm., and 889.5 cm. The displaced shallow specimens, however, form a relatively small part of the benthonic population. They belong to such species as *Cibicides lobatulus* ,*Elphidium pulvereum*, *Rosalina* spp., etc.

The following single-specimen occurrences

have been omitted from Table 16: *Biloculinella labiata* (14), *Bolivina catanensis* (71), *Bulimina costata* (24), *Elphidium advena* (53), *P. verriculata* (44, 69), *Hanzawaia rhodiensis* (83), *Rosalina obtusa* (61, 74), and *Spirophthalmidium acutimargo* (9, 92).

Core 196

Length sampled 650 cm.; depth 4270 m.; population counts given in Table 17.

According to the bottom profile given by Koczy (1956, profile 16), this core was taken in a deep depression of the ocean floor. It correlates well, however, with the adjacent Core 195. At the top there is a trace of the warm fauna present but the cold fauna increases rapidly with depth to a maximum at 29.5 cm., the top of IIa. IIa extends to 349.5 cm. showing several fluctuations, the strongest of which are at 29.5—149.5 cm., and 209.5—40 cm., the lower one being much smaller and shorter. IIb extends from 350—569.5 cm. with four warm maxima at 349.5—70 cm., 419.5 cm., 459.5 cm., and 539.5 cm. IIc extends from 569.5 cm. to the bottom. In addition to isolated samples, planktonic specimens are few or absent from 259.5—90 cm., and in several samples from 438—561 cm. *Globigerina eggeri* occurs at very high frequencies at 379.5—91 cm., and 501.5 cm. *Globorotalia truncatulinoides* is found in only five samples: at 9.5 cm. with 55 % left-coiling dominance, at 249.5 cm. with 77 % right-coiling, and with fluctuating coiling dominance below in occurrences with are too small to give statistically valid results.

The benthonic populations are less than 100 specimens except at the following depths: 29.5 cm., 499 cm., and 579.5 cm. All these occurrences are in sections where the cold planktonic fauna predominates. The smallest benthonic populations occur from 329.5—460 cm. and 501.5—40 cm., sections where the warm planktonic fauna predominates. Rare specimens displaced from shallow water are found scattered throughout most of the core, but are expecially abundant at 579.5 cm.

The following single-specimen occurrences have been omitted from Table 17: *Bolivina albatrossi* (60), *Eggerella bradyi* (60), *Elphidium complanatum* (60), *E. pulvereum* (49, 64), *Epistominella rugosa convexa* (44), *Gyroidina delicata* (7, 60), *G.* cf. *G. neosoldanii* (60), *G. umbonata* (51), *Karreriella bradyi* (34), *Nonion barleeanum* (48), *Nonionella turgida* (60), *Rosalina globulosa bradyi* (8), *Sigmoilina tenuis* (22), *Spirophthalmidium acutimargo* (49), and *Streblus beccarii* var. (7, 22).

Core 197

Length sampled 730 cm.; depth 2940 m.; population counts given in Table 18.

This core differs from the adjacent ones (196, 198) in the greater prevalence of the warm fauna which is present apparently even in most of what appears to be the IIc cold period. On Figure 6 tentative correlations have been made but they are not as clearly defined as usual. The cold fauna is found at the top increasing to a maximum at 9.5 cm., the top of IIa. IIa extends to 259.5 cm. showing two maxima at 9.5—60 cm. and 149.5 cm. IIb extends from 259.5—539.5 cm. In IIb the warm fauna shows many oscillations which may be resolved into five warm maxima at 259.5 cm., 310 cm., 409.5 cm., 451 cm., and 530 cm. The top of IIc is placed tentatively at 539.5 cm. although the warm fauna continues below. It is overshadowed, however, by the cold fauna all the way to the bottom of the core except in the section from 649.5—679 cm. The cold fauna shows four maxima at 539.5 cm., 569.5—90 cm., 639.5 cm., and 689.5 cm. Only a few isolated samples have few or no planktonic specimens. *Globigerina eggeri* occurs at very high frequencies at 141.5 cm., 310 cm., and 419.5 cm. *Globorotalia truncatulinoides* is found frequently to a depth of 230 cm., being absent below this point. At 1 cm. it shows right-

coiling dominance, below the dominance is left coiling to varying degrees. The only occurrence in the eastern Mediterranean material of *Globorotalia punctulata* is in this core at 609.5 cm.

The benthonic population is below 50 specimens in all the samples studied except the one at 99.5 cm. (98 specimens). Possibly displaced specimens occur at 559.5 cm. and 799.5 cm.

The following single-specimen occurrences have been omitted from Table 18: *Bolivina dilitata dilitatissima* (16), *B. pseudoplicata*(1), *Bulimina exilis* (15), *Cassidulina* cf. *C. oblonga* (2), *C. subglobosa* (34), *Elphidium* sp. (60), *Neoconorbina terquemi* (74), *Pyrgoella sphaera* (11), *Robulus* sp. (73), *Spiroloculina canaliculata* (27, 49), and *Wiesnerella auriculata* (1).

Core 198

Length sampled 1149 cm.; depth 3555 m.; population counts given in Table 19.

According to the depth profile given by Kroczy (1955, profile 16) this core was taken in a depressed area. The sequence of the warm and cold periods, however, appears to be normal. The warm fauna predominates at the top but decreases rapidly with depth with the exception of one minor warm oscillation at 29.5 cm. The cold fauna reaches a maximum at 49.5 cm., the top of IIa. IIa extends to 508.5 cm. with several cold maxima, the chief ones at 49.5 cm., 97.5 cm., 269.5 cm.; the lesser ones at 319.5 cm., and 419.5 cm. IIb extends from 509—719.5 cm. with three warm maxima at 509 cm., 570.5—80.5 cm., and 669.5—90 cm. IIc extends from 719.5—909.5 cm. with four cold maxima at 719.5—40 cm., 819.5—30 cm., 879.5 cm., and 929.5 cm. III extends from 969.5 cm. to the bottom. There is a cold period from 1069.5 cm. to the bottom but this is believed to correlate with the short cold oscillation found in the upper part of III in several cores. In Core 198 it has a somewhat longer extent as do all the thermal sections of the core. There are no planktonic Foraminifera in the sections at 60—97.5 cm., 120—69.5 cm., 450—508.5 cm., nor in several isolated samples. *Globigerina eggeri* occurs at very high frequencies at 879.5—90 cm. and 1009.5 cm. *Globorotalia truncatulinoides* shifts from left-coiling dominance at 19.5 cm. to right-coiling dominance at 29.5 cm. This is maintained in isolated samples to 570.5 cm. Below this point the species is absent to 949.5 cm. where left coiling is dominant. There are three further coiling-direction oscillations to 1061 cm., below which the species is absent.

The benthonic population is less than 50 specimens in all samples studied except at 879.5 cm. Benthonic specimens are absent from 570.5—670 cm. and 978.5—1020 cm., both sections being where the warm planktonic fauna is predominant. Single specimens of *Elphidium* sp., *E. crispum* and *E. pulvereum* at 1 cm., 97.5 cm., and 899.5 cm. respectively, and a single specimen of *Nonion* sp. A at 899.5 cm. are the only evidences of the presence of displaced shallow forms.

The following single-specimen occurrences have been omitted from Table 19: *Bolivina albatrossi* (11), *Bulimina costata* (11), *B. marginata* (93), *Cassidulina carinata* (93), *Elphidium crispum* (11), *E. pulvereum* (93), *E.* sp. (1), *Loxostomum alatum* (93), *Nonion* sp. A (93), *Pseudoeponides umbonatus* var. (93), *Pullenia quinqueloba* (11), *P.* cf. *P. riveroi* (110, 111), *Robulus* sp. (28), and *Sigmoilina tenuis* (93).

Core 199

Length sampled 847 cm.; depth 2370 m.; population counts given in Table 20.

The warm fauna is predominant at the top but disappears immediately below with a corresponding increase in the cold fauna. IIa extends from 9.5—442.5 cm. with several fluctuations. Cold maxima occur at 9.5 cm.,

92.5 cm., 123.5—40 cm., 255.5—67 cm., and 317.5—56 cm. Many of these are probably not indicative of true maximal conditions but merely reflect minor faunal fluctuations. IIb extends from 443—599.5 cm. with three small warm maxima at 442.5 cm., 473.5—84 cm., and 529.5—40 cm. IIc extends from 599.5 cm. to the bottom, although there is a possibility that III starts near the bottom of the core. IIc has cold maxima at 599.5 cm., 723.5 cm., and 767.5 cm. with minor fluctuations in addition. Several isolated samples contain few or no Foraminifera. There are no very high frequency occurrences of *Globigerina eggeri*, the highest (34—5 %) being from 492.5—500 cm. *Globorotalia truncatulinoides* shows left-coiling dominance at the top and is absent below for about five meters. At 492.5 cm. it shows right-coiling dominance. Below 713.5 cm. there are numerous occurrences all with left-coiling dominance.

The benthonic populations are always less than 65 specimens. As in the other cores the larger populations usually occur when the cold fauna is predominant. Displaced specimens from shallow water occur at the top, 169.5—256 cm., 310.5 cm., 362.5 cm. (?), 442.5 cm., 473.5 cm., and 549.5 cm. Such species as *Elphidium crispum*, *E. pulvereum*, *Rosalina* aff. *R. columbiensis*, etc., occur in these sections.

The following single-specimen occurrences have been omitted from Table 20: *Angulogerina angulosa* (1), *Bulimina marginata* (54, 80), *Cassidulina* cf. *C. oblonga* (1, 67), *Cibicides lobatulus* (1, 54), *C. wuellerstorfi* (14), *Elphidium advena* (19, 62), *E. granosum* (35, 50), *Epistominella rugosa convexa* (54), *Glomospira charoides* (1), *Hanzawaia rhodiensis* (54, 62), *Loxostomum alatum*, (1, 62), *Neoconorbina terquemi* (56), *Nonion* sp. B (19), *Planulina ariminensis* (54), *Pyrgo lucernula* (50, 77), *Rosalina obtusa* (1), *Sigmoilina tenuis* (10, 23), *Spirophthalmidium acutimargo* (23), *Streblus beccarii* var. (1), *Valvulineria complanata* (28, 69), and *Virgulina mexicana* (19).

Core 200

Length sampled 80 cm.; depth 2050 m.

The length of this core when collected was 498 cm. (Kullenberg, 1955), but the greater part of the core was semi-liquid so that no suitable samples could be taken for study. The section sampled contains a large quantity of sand. A few planktonic and a larger number of benthonic specimens occur. Many of the benthonic species suggest that much of the material was displaced from shallow water. Sedimentation appears to have been very rapid since planktonic specimens are usually scarce. No interpretation of climatic conditions based on them has been attempted.

Some of the most common benthonic species found are: *Bolivina catanensis*, *Bulimina marginata*, *B. costata*, *Cassidulina carinata*, *C.* cf. *C. oblonga*, *Elphidium advena*, *E. pulvereum*, *Gyroidina* cf. *G. neosoldanii*, *Nonion barleeanum*, etc. (usually *N. formosum*), *Valvulineria complanata*, and *Virgulina mexicana*.

Appendix B: Systematic Descriptions

This section includes discussions of 18 planktonic and 110 benthonic species and subspecies, of which 1 planktonic and 4 benthonic forms are new. The benthonic species described make up most of the benthonic population of the surface sediments and cores with the possible exception of those of the littoral and sublittoral zones. Many shallow-water species have been grouped together as *Elphidium* spp., Miliolidae, Peneroplidae, and *Rosalina* spp., since the individual species are represented in the samples by relatively few specimens. Taken together, however, these groups form an important part of some populations. The species of *Robulus* are grouped under *Robulus* spp. for the same reason. Additional species of which there are a considerable number are included in Tables 6—20 as »miscellaneous species».

Many of the benthonic species are widespread

in the North Atlantic or occur along the coasts of Africa, Europe, and the British Isles. About 25 % appear to be indigenous to the Mediterranean. Of the planktonic species only *Globigerinoides tenella* n. sp. has not been reported elsewhere, and may have been overlooked previously because of its small size.

Distributions in the surface sediment samples and cores are given for each benthonic species, with the depth distribution in the North Atlantic for comparison, when available. Most species are figured with the exception of a few, very well known, distinctive forms. The figured specimens have been deposited in the U. S. National Museum, Washington, D. C.

Benthonic Species

Family TOLYPAMMINIDAE

Glomospira charoides (Jones and Parker)

Trochammina squamata Jones and Parker var. *charoides* Jones and Parker, 1860, Quart. Journ. Geol. Soc., vol. 16, p. 304.

Trochammina charoides Jones and Parker. Carpenter, Jones and Parker, 1862, Introd. Foram., p. 141, pl. 11, fig. 3.

This species is reported deeper than 200 m. in the North Atlantic. It is found at thirty-two stations from 115—3499 m. (up to 100 %) with highest frequencies deeper than 731 m., at four stations showing displacement, and in scattered samples in Cores 184, 186, 187, 189, 190, 192, 197, and 199.

Glomospira cf. G. gordialis (Jones and Parker)

The specimens are similar to those referred by Phleger *et al.* (1953, p. 26, pl. 5, fig. 2) to Jones and Parker's (1860, p. 304, *Trochammina squamata* var. *gordialis*) species. It is found at fourteen stations from 567—3241 m. (up to 10 %) and at three stations showing displacement, but was not observed in the cores.

Involutina cf. I. planorbis (Höglund)

(Plate 1, figures 1, 2)

Mediterranean specimens are larger than Höglund's (1947, p. 125, pl. 8, figs. 4, 9; pl. 28, figs. 13, 14; text figs. 91, 105, 109— *Ammodiscus*) which have a maximum diameter of 0.70 mm. and a proloculus size for megalospheric forms of 29 (21—40) μ. However, he also questionably refers to his species specimens from off Portugal which have a maximum diameter of 1.40 mm. and a proloculus size for megalospheric forms of 75 (69—82) μ. The Mediterranean specimens have a maximum diameter of 0.90 mm. and a proloculus size of 60 (40—81) μ. It is possible that these measured specimens include some microspheric forms since the maximum proloculus size is almost the same as that of the Portugal specimens but the minimum is considerably less. As Höglund points out it is sometimes difficult to be sure whether specimens are megalospheric or microspheric.

This species is found at twenty stations from 143—2442 m. (up to 8 %) with the highest frequencies deeper than 665 m., at two stations showing displacement, and in two samples of Core 184.

Family TEXTULARIIDAE

Bigenerina nodosaria d'Orbigny

Bigenerina nodosaria d'Orbigny, 1826, Ann. Sci. Nat., vol. 7, p. 261, no. 1, pl. 11, figs. 9—12; Modèles, no. 57.

This species has been reported from various shallow localities in the Mediterranean. Many reported occurrences outside of this area may be erroneous. It is found at twenty-one stations from 71—799 m. (up to 5 %) and at one station showing displacement, but was not observed in the cores.

Siphotextularia concava (Karrer)

Plecanium concava Karrer, 1868, Sitz. k. Akad. Wiss. Wien, vol. 58, Abth. 1, p. 129, pl. 1, fig. 3.

This species is found at fifteen stations from 51—631 m. (up to 2 %), at three stations showing displacement, and in a few samples in Cores 192—194 associated with displaced faunas

Textularia calva Lalicker

(Plate 1, figures 3, 4)

Textularia calva Lalicker, 1935, Smithsonian Misc. Coll., vol. 91, no. 22, p. 1, pl. 1, figs. 1, 2.

Mediterranean specimens are very similar to this species. Specimens (in the U. S. National Museum) from the coast of the Island of Delos have been so identified by Lalicker. The sutures are less depressed and more obscure than those of *T. agglutinans* d'Orbigny, and the wall is more coarsely arenaceous. The chambers increase in size less rapidly as added than in *T. candeiana* d'Orbigny. *T. calva* is found at twenty-one stations from bay-567 m. (up to 5 %) and occurs rarely in Core 200.

Textularia conica d'Orbigny

(Plate 1, figures 5, 6)

Textularia conica d'Orbigny, 1839, *in* de la Sagra, Hist. Phys. Pol. Nat. Cuba, »Foraminifères», p. 143, pl. 1, figs. 19, 20.

This species is reported from the West Indies from 16—400 m. It is found at eighteen stations from 51—631 m. (up to 3 %), at one station showing displacement, and in one sample of Core 194 associated with a displaced fauna.

Textularia sagittula Defrance

Textularia sagittula Defrance, 1824, Dict. Sci. Nat., vol. 32, p. 177; Atlas Conch., pl. 13, fig. 5.

This species is sometimes referred by writers on the Mediterranean Foraminifera to »*Spiroplectammina wrightii*» (Silvestri). Lacroix (1929) has demonstrated clearly that the two species are synonymous. *T. sagittula* is found at eighteen stations from 51—366 m. and at 731 m. (up to 9 %) with the highest frequencies shoaler than 201 m., at two stations showing displacement, and in Cores 192 (twice) and 194 (once) associated with displaced faunas.

Family VERNEUILINIDAE

Pseudoclavulina crustata Cushman

(Plate 1, figure 7)

Pseudoclavulina crustata Cushman, 1936, Cushman Lab. Foram. Res., Spec. Publ. 6, p. 19, pl. 3, figs. 12 a, b.

Mediterranean specimens are identical to Cushman types from off Greece. They are found at eighteen stations from 107—731 m. (up to 5 %) but do not occur in the cores.

Family VALVULINIDAE

Eggerella bradyi (Cushman)

(Plate 1, figure 8)

Verneuilina pygmaea Brady, 1884 (not *Bulimina pygmaea* Egger, 1857), Rep't. Voy. CHALLENGER, Zool., vol. 9, p. 385, pl. 47, figs. 4—7.

Verneuilina bradyi Cushman, 1911, U. S. Nat. Mus., Bull. 71, pt. 2, p. 54, text figs. 87 a, b.

A discussion of this species is given by Phleger *et al.* (1953, p. 27). Included in the population counts are occasional specimens of adult *Karreriella bradyi* (Cushman) (pl. 1, fig. 9). Both species have been reported from the North Atlantic: *E. bradyi* deeper than *ca.* 600 m., *K. bradyi* deeper than 155 m. *E. bradyi* is found at one station showing displacement and in all the cores, except Cores 195, 198, and 200, in varying abundance.

Family MILIOLIDAE

The more common species have been identified and discussed separately. There remains, however, a large number of species (rarely represented) grouped together as »Miliolidae» in the population counts. »Miliolidae» occur at almost all stations to a depth of 1378 m. and at a few deeper ones. The highest frequencies (up to 40 %) are found shallower than 180 m.; deeper than this they do not exceed 6 % except at two deep stations where there are very few benthonic specimens. »Miliolidae» are found in all the cores.

Articulina tubulosa (Seguenza) and vars.
(Plate 1, figures 12, 13, 18, 19)

Quinqueloculina tubulosa Seguenza, 1862, Atti Accad. Gioenia Sci. Nat., ser. 2, vol. 18, p. 35, pl. 2, fig. 8.

This species appears to be a true *Articulina* although the prolongation of the uniserial chambers is unique for the genus. The species is very variable in several respects. The length of the initial quinqueloculine portion varies from *ca.* 0.07—0.43 mm. In some specimens it has a sharply angled periphery, in others a narrowly rounded one. Specimens are observed in all stages of development from those with only the quinqueloculine portion to those having three uniserial chambers. The former are more abundant but whether these are normal specimens or specimens from which the long fragile uniserial portion has been broken cannot be stated. This species occurs at five stations deeper than 684 m. (up to 20 %) and at two stations showing displacement. The highest frequencies occur deeper than 3000 m. This is one of the most abundant species in the cores and appears to be a true deep-sea form.

Biloculinella labiata (Schlumberger)
(Plate 1, figures 10, 11)

Biloculina labiata Schlumberger, 1891, Mém. Soc. Géol. France, vol. 4, p. 556, text figs. 13, 14; pl. 9, figs. 60—62.

The ratio of thickness to width of Schlumberger's figured specimens varies from 1:1.05 to 1:1.96. The specimens found in this study are more compressed, having ratios of thickness to width varying from 1:1.2 to 1:2.3. In other respects they are typical. Schlumberger reports the species from a depth of 555 m. in the Mediterranean. It occurs at twenty-one stations from 106—1378 m. (up to 5 %) mostly deeper than 287 m., at four stations showing displacement, and is associated with displaced faunas in Cores 188, 192, 194, and 195.

Miliolinella circularis (Bornemann)
(Plate 1, figures 16, 17)

Triloculina circularis Bornemann, 1855, Zeitschr. deutsch. Geol. Ges., vol. 7, p. 349, pl. 19, fig. 4.

Mediterranean specimens (max. length 0.58 mm.) are very like Bornemann's (length 0.42 mm.) except for their larger size. This is a much less compressed species than *M. dilitata* (d'Orbigny). It is found at thirty-three stations from bay-3309 m. (up to 5 %), at seven stations showing displacement, and is one of the most common species in the cores.

Pyrgo anomala (Schlumberger)
(Plate 1, figures 22, 23)

Biloculina anomala Schlumberger, 1891, Mém. Soc .Zool. France, vol. 4, p. 182, pl. 11, figs. 84—86; pl. 12, fig. 101; text figs. 32—34.

Schlumberger gives a maximum length for this species of 0.8 mm. The specimens included here have a maximum length of 0.97 mm. but in other respects appear identical. There is considerable variation in the relative width of the tooth. The species is found at sixteen stations from 75—684 but mostly deeper than 115 m. (up to 3 %), at two stations showing displacement, and in Cores 184, 186, 187, 189—194, 199, and 200.

Pyrgo lucernula (Schwager)

(Plate 1, figure 15)

Biloculina lucernula Schwager, 1866, Novara Exped., Geol. Theil., vol. 2, p. 202, pl. 4, figs. 14, 17.

This species is not found in the surface sediments but occurs in varying abundance in Cores 184, 186—190, 192, 193, 197, 199 and 200.

Pyrgo murrhina (Schwager)

Biloculina murrhina Schwager, 1866, Novara Exped., Geol. Theil., vol. 2, p. 203, pl. 4, figs. 15 a—c.

Mediterranean specimens vary in the same way as those reported by Phleger *et al.* (1953, p. 28, pl. 5, figs. 22—24). The species is found at one station at 3309 m. (5 %), and occurs in varying abundance in all cores except Cores 196 and 200.

Pyrgo serrata (Bailey)

Biloculina serrata Bailey, 1861, Boston Journ. Nat. Hist., vol. 7 (1859—1863), no. 3, p. 350, pl. 8, fig. E.

This species is found only in Core 193 (4 samples) in relatively large numbers (up to 94 specimens). For this reason it is included when other such rare species are omitted.

Pyrgoella sphaera (d'Orbigny)

(Plate 1, figure 14)

Biloculina sphaera d'Orbigny, 1839, Voy. Amér. Mérid., vol. 5, »Foraminifères», p. 66, pl. 8, figs. 13—16.

This species is found at one station at 82 m. (less than 1 %), at three stations showing displacement, and in Cores 184, 186, 188—190, 192—195, 197, and 198.

Quinqueloculina aff. **Q. lamarckiana** d' Orbigny

(Plate 1, figures 20, 21)

Mediterranean specimens have a less sharply angled periphery than d'Orbigny's (1839, p. 189, pl. 11, figs. 14, 15) species. In addition the Mediterranean form has a much deeper depth range than that given for *Q. lamarckiana* in other areas (usually shoaler than 300 m.). It is very probable that this form is not related to *Q. lamarckiana* but the writer is reluctant to add to the list of new miliolid species in the Mediterranean in view of the great number that have already been described in that area. It is very possible that this form, which is common, should be referred to one of these described species but available types must be viewed before this can be done since it apparently does not resemble any of the species as figured. It is found at nineteen stations from 75—1016 m. but mostly shallower than 680 m. (up to 2 %), at three stations showing displacement, and in varying abundance in all cores except Cores 191, 196, and 200.

Sigmoilina distorta Phleger and Parker

(Plate 1, figure 25)

Sigmoilina distorta Phleger and Parker, 1951, Geol. Soc. America, Mem. 46, pt. 2, p. 8, pl. 4, figs. 3—5.

Many specimens are typical but same are less sigmoid and compressed. The species is found at twenty-three stations from 51—731 m. (up to 2 %), at 3309 m. (45 %), at two stations showing displacement, and in Cores 192 and 200 associated with displaced faunas.

Sigmoilina schlumbergeri Silvestri

Planispirina celata Costa, sp. Schlumberger, 1887, Bull. Soc. Zool. France, vol. 12, p. 111 (481), text figs. 6, 7; pl. 7, figs. 12—14 (*Sigmoilina* (*Planispirina*) *celata* in expl. of pl.).

Sigmoilina schlumbergeri Silvestri, 1904, Mem. Pont. Accad. Nuovi Lincei, vol. 22, p. 267.

This species is reported from the North Atlantic deeper than 80 m. It is found at eighteen stations from 179—1016 m. (up to

4 %), at two stations showing displacement, in three samples of Core 193, and one sample of Core 196 associated with displaced faunas.

Sigmoilina tenuis (Czjzek)

(Plate 1, figure 24)

Quinqueloculina tenuis Czjzek, 1848, Haidinger's Nat. Abhandl., vol. 2, p. 149, pl. 13, figs. 31—34.

This species is reported in the Bay of Naples deeper than 200 m. It is found at ten stations from 205—1016 m. (up to 1 %), at five stations showing displacement, and in Cores 184, 186, 188, 192—194, 196, 198, and 199.

Spiroloculina angulosa Terquem

(Plate 1, figures 29, 30)

Spiroloculina angulosa d'Orbigny [nomen nudum], 1826, Ann. Sci. Nat., vol. 7, p. 298, no. 9; Terquem, 1878, Mém. Soc. Géol. France, ser. 3, vol. 1, p. 53, pl. 5 (10), fig. 7.

Rare specimens of *S. depressa* d'Orbigny may be included in the population counts but in most cases typical *S. angulosa* occurs. It is found at eleven stations from 71—541 m. and at 1016 m. (up to 1 %), at three stations showing displacement, and in a few samples in Cores 188 and 192 associated with displaced faunas.

Spiroloculina canaliculata d'Orbigny

(Plate 1, figures 26, 27, 28)

Spiroloculina canaliculata d'Orbigny, 1846, Foram. Foss. Bass. Tert. Vienne, p. 269, pl. 16, figs. 10—12.

Mediterranean specimens are larger and thicker than those of the Vienna Basin Miocene with a maximum length of slightly more than 1.0 mm. and a maximum thickness of 0.25 mm. Some of the specimens have a very wrinkled periphery (*vide* pl. 1, fig. 27). This species is found at nineteen stations from 21—1016 m. (up to 1 %), at three stations showing displacement, and in Cores 184, 186—189, 192—194, 197, and 199 but rarely except in Cores 192 and 193.

Spiroloculina grata Terquem

(Plate 1, figure 31)

Spiroloculina grata Terquem, 1878, Mém. Soc. Géol. France, ser. 3, vol. 1, p. 55, pl. 5 (10), figs. 14 a—15 b.

This species is found at fifteen stations from bay—859 m. but mostly shallower than 287 m. (up to 2 %), at six stations showing displacement, and in Cores 188, 192, and 194—196, associated with displaced faunas.

Family OPHTHALMIDIIDAE

Spirophthalmidium acutimargo (Brady)

Spiroloculina acutimargo Brady (part), 1884, Rep't. Voy. CHALLENGER, Zool., vol. 9, p. 154, pl. 10, fig. 13 (*not* figs. 12, 14, 15).

Included in the populations counts are a few specimens of the concavo-convex form referred by Heron-Allen and Earland (1916, p. 208, pl. 39, figs. 1—3) to »*Spiroloculina acutimargo* var. *concava*». It is probable that these are merely variant forms of *S. acutimargo*. This species is found at sixteen stations from 205—1378 m. (up to 14 %), at five stations showing displacement, and in scattered samples in all the cores except Cores 191, 197, 198, and 200.

Wiesnerella auriculata (Egger)

Planispirina auriculata Egger, 1893, Abhandl. k. bay Akad. Wiss. München, Cl. II, vol. 18, p. 245, pl. 3, figs. 13—15.

This species is not found in the surface sediments but occurs in Cores 192—197.

Family PENEROPLIDAE

Representatives of this family are found only at Sta. B. S. 32 in Piraeus Harbor (6 %).

Family LAGENIDAE

Lagenonodosaria scalaris (Batsch)

(Plate 1, figures 32, 33)

Nautilus (*Orthoceras*) *scalaris* Batsch, 1791, Conch. des Seesandes, no. 4, pl. 2, figs. 4 a, b.

This species is assigned by some authors to the genus *Amphicoryna* Schlumberger but the writer is not sure that the rare specimens having a coiled initial portion are referrable to Batsch's species and it is, therefore, referred here to *Lagenonodosaria*. It is found at twenty-four stations from 82—996 m. (up to 5 %), at five stations showing displacement, and rarely in Cores 188, 192, 194, and 200, associated with displaced faunas.

Lenticulina peregrina (Schwager)

Cristellaria peregrina Schwager, 1866, Novara Exped., Geol. Theil., vol. 2, p. 245, pl. 7, fig. 89.

This species is reported in the North Atlantic deeper than 90 m. It is found at eight stations from 567—1016 m. (up to 2 %), at three stations showing displacement and in Cores 192 and 200 associated with displaced faunas.

Robulus spp.

Specimens of this genus are found at twenty-eight stations from 51—1016 m. (up to 4 %), at five stations showing displacement, and in scattered samples in all the cores except Cores 195 and 196.

Family NONIONIDAE

Astrononion stelligerum (d'Orbigny)

(Plate 1, figures 34, 35)

Nonionina stelligera d'Orbigny, 1839, *in* Barker-Webb and Berthelot, Hist. Nat. Iles Canaries, vol. 2, pt. 2, »Foraminifères», p. 128, pl. 3, figs. 1,2.

As pointed out previously (Parker, 1952, p. 410, »*Astrononion stellatum* Cushman and Edwards») this species is similar to *A. gallowayi* Loeblich and Tappan but differs in having 8—10 (usually 9—10) chambers in the final whorl and more inflated chambers. It is found at ten stations from 51—1016 m. (up to 2 %), with only two occurrences deeper than 179 m. (0.3 %), at one station where there are many displaced specimens, and associated with displaced faunas in Cores 192, 194, and 195.

Nonion barleeanum (Williamson), etc.

(Plate 1, figures 36, 37)

Nonionina barleeana Williamson, 1858, Rec. Foram. Great Britain, p. 32, pl. 3, figs. 68, 69.

This species has been combined with *N. formosum* (Seguenza) (pl. 1, figs. 38, 39) in the population counts since the two species usually occur together and are difficult to differentiate when counting. Both species have test walls showing a granular structure (Bramlette, personal communication). The related species, *N. pompilioides* (Fichtel and Moll), does not occur. The species are found (one or both) at thirty-seven stations from 51—3974 m. (up to 42 %) and in Cores 184, 186, 188, 191—194, 199, and 200, usually associated with displaced faunas. The reason for this association with displaced species is unknown since both have a deep range. It has been noted previously that there is frequently an increase in the number of deep ranging species present in samples which contain presumably displaced shallow species.

Nonion sp. A

(Plate 1, figures 42, 43)

This is a small (max. diam. 0.34 mm.), thin-walled species, compressed, with 9—10 chambers in the final whorl. The umbilical area and inner parts of the sutures are usually filled with fine papillae. The wall has a granular structure and the perforations, if present, are smaller than 2—3 μ (Bramlette, personal communication). The species is apparently new but insufficiently common to describe as such. It is not found in the surface sediments but occurs

in Cores 191—196, and 198 associated with displaced faunas. The uppermost occurrence in the samples studied is at 9.5 cm. in Core 195, but usually it appears much lower in the section.

Nonion sp. B

(Plate 1, figures 40, 41)

This is a small (max. diam. *ca.* 0.37 mm.), rather compressed species with a thickened keel, incised sutures, an umbilical plug, and 9—12 chambers in the final whorl. The sutures appear to have small retral processes, although they are difficult to detect. The wall is granular and so finely perforate that the pores are not visible when viewed with a magnification of 250 X (Bramlette, personal communication). This species, like the previous one, is probably new but is insufficiently common to describe as such. It is found at five stations from 51—567 m. (up to 1 %), at three stations showing displacement, and in Cores 188, 191, 192, 194—196, and 199, associated with displaced faunas.

Nonionella turgida (Williamson)

Rotalina turgida Williamson, 1858, Rec. Foram. Great Britain, p. 50, pl. 4, figs. 95—97.

It is possible that occasional specimens referrable to *N. opima* Cushman are included in the population counts. *N. turgida* is found at three stations from 86—567 m. (less than 1 %), at one station showing displacement, and in scattered samples in Cores 187—194, 196, and 200, associated with displaced faunas.

Family BULIMINIDAE

Angulogerina angulosa (Williamson)

(Plate 2, figures 1, 2)

Uvigerina angulosa Williamson, 1858, Rec. Foram. Great Britain, p. 67, pl. 5, fig. 140.

Specimens are usually somewhat broader relative to length than most of those from the British Isles, but identical ones have been observed in material from the vicinity of Ireland. The species is reported from shallow stations in the British Isles. Parker (1948) reports it from the continental shelf of the eastern United States deeper than 63 m. It is found at seven stations from 179—731 m. (up to 4 %), at three stations showing displacement, and associated with displaced faunas in Cores 188, 191—195, and 199.

Bolivina albatrossi Cushman

(Plate 2, figures 3, 4)

Bolivina albatrossi Cushman, 1922, U. S. Nat. Mus., Bull. 104, pt. 3, p. 31, pl. 6, fig. 4.

This species is reported in the North Atlantic and the Gulf of Mexico deeper than *ca.* 200 m. but is confined to deeper water sediments in the eastern Mediterranean. It is found at five stations from 567—1378 m. (up to 4 %), at four stations showing displacement, and in varying abundance in eleven cores, most commonly in Cores 184 and 186. That the depth range may be deeper than that shown by the distribution in surface sediment samples is suggested by the absence of displaced shallow specimens in the core samples in which the species is found.

Bolivina attica Parker, n. sp.

(Plate 2, figures 12, 13, 14)

Test medium in size, very slightly tapering, ratio of length to width *ca.* 1: 3, often terminated by a short, stubby spine; periphery sharply angled to slightly rounded, often with a narrow keel; chambers narrow, up to 23 in number; sutures flush with the surface, slightly limbate, especially in the upper part of the chamber, slightly curved, slanting at an angle of about 45° except near the outer part of the test where the downward slope is steeper; wall with medium-sized perforations, ornamented on the lower half of the test with 10—12 low costae. Maximum length 0.65 mm., width 0.2 mm., thickness 0.1 mm.

The holotype (U. S. N. M. P6123) and figured paratypes (U. S. N. M. P6124 a, b) are from the

Aegean Sea, Atlantis Sta. B. S. 20 (Cruise 151), Lat. 39° 19′ N., Long. 26° 00′ E., at a depth of 210 m.

This species is not variable except in the character of the periphery which is usually keeled but sometimes slightly rounded, especially in the initial portion. As is usual in this genus, the microspheric form, being more pointed at the initial end, is more tapered. *B. attica* differs from *B. acutula* Bandy (originally *B. advena* Cushman var. *acutula* Bandy) in its greater length and compression, coarser perforations, basal spine, more numerous chambers, and straighter sutures and from *B. striatula* Cushman in its greater length and compression, undepressed sutures, and small terminal spine.

This species is found at eight stations from 82—338 m. (up to 2 %), at one deep station containing displaced specimens, and rarely in Cores 188, 191, 192, and 194, associated with displaced faunas.

Bolivina catanensis Seguenza

(Plate 2, figures 10, 11)

Bolivina catanensis Seguenza, 1862, Atti Accad. Gioenia Sci. Nat., ser. 2, vol. 18, p. 29, pl. 2, figs. 3 a, b.

This species differs from *B. spathulata* (Williamson) in its less tapered test and straighter sutures. It is possible that some specimens of the latter have been included in the population counts but most specimens conform closely to Seguenza's species. Specimens reported from the Mediterranean by various authors as *B. dilitata* may be referrable to *B. catanensis*. As pointed out by Marks (1951, p. 59), *B. dilitata* probably has sigmoid sutures whereas those of *B. catanensis* are almost straight.

B. catanensis is found at sixteen stations from 71—1016 m. (up to 8 %), mostly shallower than 567 m., at three stations showing displacement, and in Cores 186, 188, 192, 194—196, 198—200, but most commonly in Core 186.

Bolivina difformis (Williamson)

(Plate 2, figure 9)

Textularia variabilis Williamson var. *difformis* Williamson, 1858, Rec. Foram. Great Britain, p. 77, pl. 6, figs. 166, 167.

The Mediterranean species is like observed specimens from the vicinity of Ireland. The species is found at five stations from 115—567 m. (up to 3 %), at two stations showing displacement, and associated with displaced faunas in Cores 188 and 191—196.

Bolivina dilitata dilitatissima Silvestri

(Plate 2, figures 5, 6, 7)

Bolivina dilitata Reuss var. *dilitatissima* Silvestri, 1893, Mem. Accad. Pont. Nuovi Lincei, vol. 9, p. 100.

It is unfortunate that Silvestri did not illustrate this form. The present identification is based on the marked resemblance of the specimens to *B. dilitata* and the greater ratio of width to length as indicated by Silvestri. They differ also from the typical form in their greater size, up to 0.58 mm. in length. It is of interest to note that Silvestri also reports *B. dilitata* from the Ionian Sea, noting that this is the species referred to *B. catanensis* by Seguenza. Specimens referred here to Silvestri's variety, however, have somewhat sigmoid sutures like those of *B. dilitata* as defined by Marks (1951, p. 59) and show a marked resemblance to observed Vienna Basin specimens. As noted previously *B. catanensis* has almost straight sutures. It appears, then, that Silvestri erred in his identification of *B. dilitata*, but, if my interpretation is correct, did not do so in relating his »variety» to that species. Specimens included in this subspecies vary greatly in the amount of limbation and raised character of the sutures, which are also occasionally slightly crenulated. An attempt was made to subdivide them according to the character of the sutures but there seemed no logical way to do so, and it is now believed that

the form is a very variable one. It is found at seventeen stations from 106—1378 m. (up to 9 %), at four stations showing displacement, and in varying quantities in most of the cores, being most abundant in Core 184.

Bolivina pseudoplicata Heron-Allen and Earland

(Plate 2, figure 8)

Bolivina pseudoplicata Heron-Allen and Earland, 1930, Journ. Roy. Micr. Soc., vol. 50, p. 81, pl. 3, figs 36—40.

In the North Atlantic this species is reported shoaler than 200 m. It is found at eight stations fom 104—2760 m. (up to 50 %), at four stations showing displacement, and in most of the cores, being very common in many of them.

Bolivina subaenariensis Cushman

(Plate 2, figures 15, 16)

Bolivina subaenariensis Cushman, 1922, U. S. Nat. Mus., Bull. 104. pt. 3, p. 46, pl. 7, fig. 6.

This species is reported from the Mediterranean area by many authors as *B. aenariensis* (Costa). Pliocene specimens from near Coroncina, Italy, referred questionably to that species by Cushman (1937, p. 105), are smaller, with less limbate sutures and finer costae. If Cushman's identification is correct, the modern species should be referred to *B. subaenariensis*. If not, the possibility remains that Cushman's and Costa's species are synonymous, but a study of Costa's types will be necessary to settle this. *B. subaenariensis* is reported deeper than 114 m. in the North Atlantic. It is found at two stations from 106—143 m. (less than 1 %), at one station showing displacement, in the lower two-thirds of Core 184 (abundant), and in Cores 187 and 188 (one specimen in each).

Bulimina aculeata d'Orbigny

(Plate 2, figures 17, 18)

Polymorphium pineiformium Soldanii (pt.), 1791 Testacea, vol. 1, pt. 2, p. 118, pl. 127, fig. 1?; pl. 130, fig. vv.

Bulimina aculeata d'Orbigny, 1826, Ann. Sci. Nat., vol. 7, p. 269, no. 7.

This species is reported in the North Atlantic from 100—2800 m. It is found at one station at 179 m. (1 %) and in Cores 189, 190, 191, 193. and 194. In some cases it occurs in great abundance, for example two occurrences of 1280 and 896 specimens in Core 189.

Bulimina costata d'Orbigny

(Plate 2, figures 19, 20)

Bulimina costata d'Orbigny, 1852, Prod. Pal. Strat. Anim. Moll. Ray., vol. 3, p. 194; Fornasini, 1901, Soc. Geol. Ital. Boll., vol. 20, p. 174, text fig. 1.

This is a very common species in the area, being found at thirty stations from 82—3241 m. (up to 16 %), at seven stations showing displacement, and in most of the cores.

Bulimina exilis Brady

(Plate 2, figure 29)

Bulimina elegans d'Orbigny var. *exilis* Brady, 1884, Rep't. Voy. CHALLENGER, Zool., vol. 9, p. 399, pl. 50, figs. 5, 6.

This species is reported from 359—2743 m. in the North Atlantic. It is found at one station showing displacement and in occasional samples in most of the cores. In Core 186 it is very common.

Bulimina gibba Fornasini

(Plate 2, figures 21, 22)

Bulimina gibba Fornasini, 1901, Accad. Sci. Istit. Bologna Mem., ser. 5, vol. 9, p. 378, pl. 0, figs. 32, 34.

This species shows considerable variation in the number of spines ornamenting the test but all specimens have the angled lower portion of the test. The species is found at eleven stations from 71—658 m. (up to 11 %), at one station showing displacement, and in Cores 184, 186—188, 191, 192, 194, 199, and

200, in all cases apparently associated with displaced faunas except in Core 187 where displacement cannot be proved.

Bulimina marginata d'Orbigny

(Plate 2, figure 23)

Bulimina marginata d'Orbigny, 1826, Ann. Sci. Nat., vol. 7, p. 269, no. 4, pl. 12, figs. 1—12.

This species is reported from shallow water to a depth of 2981 m. in the North Atlantic. It is found at twenty-seven stations from 82—1016 m. (up to 13 %), at all stations showing displacement, and in most of the cores in varying amounts. It is especially common in Core 184 and the lower part of Core 194, in both cases frequently associated with displaced faunas.

Globobulimina affinis (d'Orbigny)

(Plate 2, figures 24, 25)

Bulimina affinis d'Orbigny, 1839, *in* De la Sagra, Hist. Phys. Pol. Nat. Cuba, »Foraminifères», p. 105, pl. 2, figs. 25, 26.

This species is reported from the North Atlantic deeper than 97 m. It is not found in the surface sediments but occurs in Cores 184, 186—190, 192—194, 197, 199, and 200, being especially abundant in Cores 184 and 193.

Globobulimina pseudospinescens (Emiliani)

(Plate 2, figures 26, 27)

Bulimina pyrula d'Orbigny var. *pseudospinescens* Emiliani, 1949, Riv. Ital. Pal. Strat. Milan, vol. 55, no. 1, p. 9, pl. 2, figs. 24, 25.

Emiliani places »*Bulimina pyrula* var. *spinescens* Brady» of Flint (1899) in the synonymy of his variety. Flint reports his form from off the coast of Maryland where *Globobulimina* (*Desinobulimina*) *turgidus* (Bailey) is abundant and it is probably synonymous with that species. *G. pseudospinescens* differs from *G.* (*D.*) *turgidus* (max. length 1.0+ mm.) in its smaller size (figured specimens 0.7 mm. in length), in not including specimens with a terminal aperture within its range of variation, and in having a more involute test. In the latter characteristic it more nearly approaches *G. pyrula* (d'Orbigny) but is still more involute, less ovate in shape, and larger than that species. Eastern Mediterranean specimens are slightly smaller than Emiliani's figured specimens but otherwise appear identical.

This species is found at two stations from 658—665 m. (2 %), at three stations showing displacement, and in scattered samples in Cores 184, 188, 192, 193, and 199.

Globobulimina? sp.

(Plate 2, figure 28)

This is a very fragile, thin-shelled form; complete specimens are seldom seen. It is placed tentatively in the genus *Globobulimina* although in regard to the apertural characters it more closely resembles *Virgulina*. There is no protruding tooth and the successive apertures are connected by a simple tongue attached to the apertural border.

The species is not found in the surface sediments but occurs in scattered samples in Cores 189, 190, 192—195, 198, and 200, associated with displaced faunas.

Loxostomum alatum (Seguenza)

(Plate 2, figures 30, 31, 32)

Vulvulina alata Seguenza, 1862, Atti Accad. Gioenia, Sci. Nat., ser. 2, vol. 18, p. 115, pl. 2, figs. 5, 5 a.

This species is on the borderline between *Loxostomum* and *Bolivina*. It is placed in the former for the following reasons: 1) Seguenza's figured specimens appear to have a terminal aperture; 2) specimens from the Bay of Naples where he reported it have a terminal aperture; 3) many of the eastern Mediterranean specimens have a terminal aperture. The species is found at seven stations from 205—684 m. (less than

1 %), at two stations showing displacement, and in Cores 184, 186—188, 192—194, 196, and 198—200.

Reussella spinosissima (Costa)

(Plate 2, figure 33)

Verneuilina spinosissima Costa, 1856, Atti Accad. Pont., vol. 7, pt. 2, p. 263, pl. 23, figs. 5 a—c.

This species is found at eleven stations from bay—117 m. (up to 4 %), at 3309 m., at one station showing displacement, and in one sample in Core 188 and two in Core 194, associated with displaced faunas.

Robertina translucens Cushman and Parker

(Plate 2, figure 34)

Robertina translucens Cushman and Parker, 1936, Contr. Cushman Lab. Foram. Res., vol. 12, pt. 4, p. 99, pl. 16, figs. 8 a, b.

Robertina is included in the Buliminidae with some hesitation. The genus seems to be related to genera in several families depending on which characteristics are emphasized.[1]) *R. translucens* is found at fourteen stations from 179—1265 m. and 3241 m. (up to 3 %), at five stations showing displacement, and in varying abundance in all the cores except Cores 184 and 200.

Uvigerina auberiana d'Orbigny

(Plate 2, figures 35, 36)

Uvigerina auberiana d'Orbigny, 1839, *in* De la Sagra, Hist. Phys. Pol. Nat. Cuba, »Foraminifères», p. 106, pl. 2, figs. 23, 24.

Mediterranean specimens are similar to those of the smaller size-group found in the North Atlantic by Phleger *et al.* (1953, p. 37). The species is found at fifteen stations from 179—731 m. and 1265 m. (up to 9 %), at four stations showing displacement, and in Cores 191, 192, 194, and 200 associated with displaced faunas.

[1]) This species is referred to *Robertina* for reasons previously published (Parker, 1952, p. 416).

Uvigerina mediterranea Hofker

(Plate 2, figures 39, 40)

Uvigerina mediterranea Hofker, 1932, Publ. Staz. Zool. Napoli, vol. 12, fasc. 1, p. 118, text figs. 32 a—g.

U. finisterrensis Colom (1952, p. 27, text fig. 4, pl. 4, figs. 1, 2, 13, 14) may be a synonym of Hofker's species. Eastern Mediterranean specimens show considerable variation in size of tests and coarseness of costae. The specimens all appear to belong to the same taxon and most of them are similar to those described by Hofker. The species is one of the most common in the surface sediments. It is found at thirty-seven stations from 82—3241 m. (up to 48 %), at six stations showing displacement, in Core 184 (abundantly), and in scattered samples in Cores 188, 189, 192, and 199. In all the core samples studied, except Core 189, it is associated with displaced faunas which seems strange in view of its deep depth occurrence in surface sediments.

Uvigerina peregrina Cushman

(Plate 2, figures 37, 38).

Uvigerina peregrina Cushman, 1923, U. S. Nat. Mus., Bull. 104, pt. 4, p. 166. pl. 42, figs. 7—10.

Eastern Mediterranean specimens are somewhat smaller (max. length *ca.* 0.68 mm.) than those described by Cushman (max. length 0.85 mm.), but are otherwise very similar to topotype specimens. The species is reported in the North Atlantic deeper than 29 m. (usually much deeper) by Cushman and deeper than 610 m. off the northeastern United States by Parker (1948). It is found at one station at 1016 m. (4 %), at two stations showing displacement, and in Cores 184, 186, 188, 191—194, and 199.

Family SPIRILLINIDAE

Patellina corrugata Williamson

Patellina corrugata Williamson, 1858, Rec. Foram. Great Britain, p. 46, pl. 3, figs. 86—89.

This species is widely reported from all depths in the North Atlantic. It is found at three stations from 567—1378 m. (up to 2 %), at three stations showing displacement, and in scattered samples in Cores 184, 187—189, and 191—196.

Spirillina vivipara Ehrenberg

(Plate 3, figure 4)

Spirillina vivipara Ehrenberg, 1841, Abh. k. Akad. Wiss. Berlin, p. 422, pl. 3, sec. 7, fig. 41.

This species has been reported in the North Atlantic to a depth of 366 m. It is found at thirteen stations from 71—996 m. (up to 3 %), at six stations showing displacement, and in scattered samples in Cores 184, 188, 192, 194, and 196, associated with displaced faunas.

Spirillina wrightii Heron-Allen and Earland

(Plate 3, figures 1, 2, 3)

Spirillina wrightii Heron-Allen and Earland, 1930, Journ. Roy. Micr. Soc., vol. 50, p. 181, pl. 4, figs. 54—58.

This species is referred by Cushman (1931, p. 81, pl. 2, figs. 4, 5) to *S. limbata* Brady var. *denticulata* Brady. Cushman says that Brady did not »mention» the difference of the two sides, but it seems very unlikely that he would have ignored such a feature. For this reason the species with the tubercles on the ventral side is referred here to *S. wrightii*. A study of Brady's types would settle this question. The species is found at four stations from 75—143 m. (up to 3 %), at two stations showing displacement, and in one sample in Core 194 associated with a displaced fauna.

Family DISCORBIDAE

Asterigerinata mamilla (Williamson)

(Plate 3, figures 5, 6)

Rotalina mamilla Williamson, 1858, Rec. Foram, Great Britain, p. 54, pl. 4, figs. 109—111.

This species has been reported from shallow water. Phleger *et al.* (1953) report it (as *Discorbis mamilla*) from displaced faunas in the North Atlantic cores. It is found at twelve stations, mostly in the Aegean Sea, from bay-179 m. (up to 30 %), at three stations showing displacement, and associated with displaced faunas in Cores 186, 187, 194, and 195.

Eponides repandus (Fichtel and Moll)

Nautilus repandus Fichtel and Moll, 1798, Test. Micr., p. 35, pl. 3, figd. a—d.

This species is reported from the North Atlantic shallower than 170 m. It is found at nine stations from 51—567 m. (up to 4 %) but does not occur in the core samples studied.

Gavelinopsis praegeri (Heron-Allen and Earland)

(Plate 3, figures 24, 25)

Discorbina praegeri Heron-Allen and Earland, 1913, Proc. Roy. Irish Acad., vol. 31, pt. 64, p. 122, pl. 10, figs. 8—10.

G. translucens (Phleger and Parker) (*Rotalia translucens* Phleger and Parker, 1951) is occasionally included in the population counts of the core faunas. It differs from *G. praegeri* in being plano-convex while the latter is convexo-concave or flat on the ventral side. This difference is very apparent when comparing specimens of *G. praegeri* from the British Isles and *G. translucens* from the Gulf of Mexico; near the former only *G. praegeri* occurs, in the latter only *G. translucens*. In the eastern Mediterranean surface sediments only *G. praegeri* is found but both species occur in the cores, sometimes concurrently. When this happens they are difficult to separate in rapid routine counting of populations. It is interesting to

speculate on the possibility of the two species in the cores belonging to the same taxon which has since developed along different lines in the Recent Mediterranean and other areas. In North Atlantic cores collected by the Swedish Deep-Sea Expedition, *G. praegeri* was reported in Core 290 north of Latitude 40° N, while *G. translucens* occurred in Cores 228 and 252 south of Latitude 16° N (Phleger, *et al.*, 1953). *G. praegeri* s. s. is found at twenty-four stations from 71—1265 m. (up to 5 %) and at five stations showing displacement. Both species (or sometimes *G. praegeri* only) occur in varying abundances in all cores except Cores 197—200.

Gyroidina altiformis R. E. and K. C. Stewart
(Plate 3, figures 10, 11, 12)

Gyroidina soldanii d'Orbigny var. *altiformis* R. E. and K. C. Stewart, 1930, Journ. Pal., vol. 4, no. 1, p. 67, pl. 9, fig. 2.

This species does not appear to be related to *G. soldanii* (*vide G.* cf. *G. neosoldanii*) since it has oblique rather than radial sutures. It is found at thirty-four stations from 201—2442 m. (up to 34 %), at seven stations showing displacement, and in Cores 184, 186, 192, 193, 197 (?), and 199, being found in abundance only in Core 184.

Gyroidina delicata Parker, n. sp.
(Plate 3, figures 7, 8, 9)

Test relatively small for the genus, plano-convex or with the central part of the dorsal side sometimes protruding slightly, consisting of about three whorls, umbilicus closed, upper edge of the periphery rather sharply angled, usually slightly lobulate; chambers 6—8 (occasionally 9) in the final whorl; sutures distinct, narrow, oblique, slightly depressed on the dorsal side, on the ventral side slightly curved, slightly depressed; wall comparatively thin, slightly translucent, densely perforate with very fine pores; aperture extending from the umbilicus to about three-fourths of the way to the periphery, with a narrow lip. Maximum diameter 0.4 mm. (most specimens smaller); maximum thickness 0.25 mm.

The holotype (U. S. N. M. P6340) and figured paratypes (U. S. N. M. P6341 a, b) are from Core 193, no. 57, 549.5—550 cm. from the top, Lat. 34° 12′ N, Long. 0° 24.22′ E, at a depth of 2130 m.

This species differs from *G. altiformis* in its smaller size, less acute periphery, lack of a deep open umbilicus, and more depressed sutures (except on dorsal side, final whorl of *G. altiformis*). In the adult specimens on the dorsal side the final chambers are sometimes slightly tipped inward and back so that the previous chambers jut above. This feature is also seen in *G. altiformis*, which also often has limbate sutures although this seems to be a variable characteristic. Specimens referred by Parker (1954, pl. 7, figs. 9, 10) to *G. neosoldanii* Brotzen are very similar though larger; this is also true of part of the specimens referred to *G. soldanii* d'Orbigny vars. by Phleger, *et al.* (1953).

G. delicata is not found in the surface sediments but occurs in all the cores except Cores 184 and 199. The highest occurrence is in Core 196 at 59.5 cm. but usually it does not appear until much deeper in the section.

Gyroidina cf. **G. neosoldanii** Brotzen
(Plate 3, figures 13, 14, 15, 16, 17, 18)

Gyroidina orbicularis Phleger, Parker, and Peirson, 1953 (not d'Orbigny, 1826), Rep'ts. Swedish Deep-Sea Exped., vol. 7, no. 1, p. 41, pl. 8, figs. 35, 36.

Brotzen (1936, p. 158) renamed Brady's (1884, p. 706, pl. 107, figs. 6, 7) »*Rotalia soldanii* d'Orbigny». Brady's figured specimens, however, appear to represent two species: fig. 6, with oblique sutures; fig. 7, with radiate sutures. The former somewhat resembles *G. delicata* Parker, n. sp., but appears to be a much larger heavier form; the latter resembles the Mediterranean specimens considered here (max.

	G. orbicularis	*G. soldanii*	*G.* cf. *G. neosoldanii*
max. size: diameter	0.68 mm.	0.56 mm.	0.54 mm.
max. size: thickness	0.50 mm.	0.40 mm.	0.36 mm.
no. of whorls	2—1/2	3	3
character of whorls	broad	narrow	medium, outer one of large forms narrow
umbilicus	closed	open	closed except in large forms when the opening is small and deep
sutures	radiate	radiate	radiate
spiral suture	flush	outer whorl channeled	outer whorl of large specimens channeled

diam. 0.54 mm.) although it is somewhat larger (0.72 mm.) and seems to have a more rounded periphery. As previously mentioned (*vide G. delicata*) the specimens from the eastern Gulf of Mexico referred by Parker (1954, p. 528, pl. 9, figs. 9, 10) to *G. neosoldanii* have oblique sutures. A study of various species of the genus *Gyroidina* leads me to believe that the angle of the sutures is not a variable feature and is, therefore, important in specific diagnosis. Before the characteristics of *G. neosoldanii* can be precisely defined it will be necessary to study Brady's figured specimens and to designate a type for the species. It seem unwise to do so from a review of the figures. Designations of this kind have frequently been made from figured specimens but the practice is a dangerous one and often leads to worse confusion. Specimens referred by various authors to *G. orbicularis*, and to a somewhat less extent to *G. soldanii*, in the Mediterranean, North Atlantic, and Gulf of Mexico are similar to Brady's fig. 7, and to the specimens here referred tentatively to *G. neosoldanii*. Topotypes from Rimini, Italy, apparently referrable to d'Orbigny's two species (*orbicularis*, *soldanii*) are unlike anything I have seen in the Mediterranean samples and are probably derived from nearby fossil localities. The following table shows the characteristics of the various forms:

From this table it appears that the Recent Mediterranean species is closer to *G. soldanii* than *G. orbicularis*. The Mediterranean specimens fall roughly into two groups. One group (pl. 3, figs. 16, 17, 18) contains smaller, more compressed specimens and is the one most frequently referred by authors to *G. orbicularis* since it does not show channeling of the spiral suture. (It differs from that species in its small size, greater compression (ratio of diameter to thickness nearly 2: 1)) and increased number of whorls). The great difficulty, however, of consistently separating these small specimens from the larger ones leads to the belief that they belong to the same taxon.

It is of interest to note that the specimens referred by Phleger, *et al.* (1953) to »*G. soldanii* variants» have oblique sutures and are therefore not referrable to that species.

G. cf. *G. neosoldanii* is found at thirty-six stations from 106—2738 m. (up to 82 %) mostly deeper than 200 m. and with the highest frequencies deeper than about 650 m., at five stations showing displacement, and in varying abundances in all the cores expect Cores 195 and 198.

Gyroidina umbonata (Silvestri)

(Plate 3, figures 19, 20)

Rotalia soldanii d'Orbigny var. *umbonata* Silvestri, 1898, Mem. Accad. Pont. Nuovi Lincei, vol. 15, p. 329, pl. 6, figs. 14 a—c.

This species is found at fifteen stations from 205—1016 m. (up to 2 %), at four stations

showing displacement, and in scattered samples in Cores 184, 186, 188, 192, 194, 196, and 200, usually associated with displaced faunas.

Hanzawaia rhodiensis (Terquem)
(Plate 3, figures 21, 22, 23)

Truncatulina rhodiensis Terquem, 1878, Mém. Soc. Géol. France, ser. 3, vol. 1, pt. 3, p. 21, pl. 1, fig. 26.

This genus is placed in the Discorbidae since its closest affiliation appears to be with *Rosalina*. The genera *Hanzawaia* Asano 1944 and *Cibicidina* Bandy 1949 are considered to be synonymous since the »supplementary lobes» in the umbilical area of the type species of the former are present, though to a lesser degree, in the latter. This differential development of the »supplementary lobes» does not seem a sufficient basis for generic differentiation. *H. rhodiensis* is found at twenty-five stations from 51—1378 m. (up to 7 %) with the greatest abundance from 51—106 m., at six stations showing displacement and in Cores 186, 188, 191—195, 199, and 200, in scattered samples associated with displaced faunas.

Neoconorbina terquemi (Rzehak)
(Plate 3, figures 26, 27)

Rosalina orbicularis Terquem, 1876 (not *R. orbicularis* d'Orbigny, 1850), Anim. sur la Plage de Dunkerque, p. 75, pl. 9, figs. 4 a, b.

Discorbina terquemi Rzehak, 1888, Austria, Geol. Reichs., Verh., p. 228.

This species is found at twenty stations from bay—799 m. (up to 7 %) with the highest frequencies shallower than 117 m., at six stations showing displacement, and in Cores 188, 191—197, 199, and 200, often associated with displaced faunas.

Neoconorbina williamsoni (Parr)
(Plate 3, figures 28, 29)

Rotalina nitida Williamson, 1858, Rec. Foram. Great Britain, p. 54, pl. 4, figs. 106—108.

Discorbis williamsoni Parr, 1932, Proc. Roy. Soc. Victoria, vol. 44 (n. s.), pt. 2, p. 226, pl. 21, fig. 25.

This species is found at two stations from 117—179 m. (less than 1 %), at three stations showing displacement, and in Cores 184, 188, 190—196, 198, 199, and 200, mostly associated with displaced faunas.

Pseudoeponides umbonatus (Reuss) var.
(Plate 3, figures 30, 31, 32)

Eponides umbonatus (Reuss) and variants, Phleger, Parker, and Peirson, 1953 (part), Rep'ts. Swedish Deep-Sea Exped., vol. 7, no. 1, p. 42, pl. 9, figs. 9, 10.

The variant figured by Phleger *et al.* is identical to the Mediterranean form. Typical specimens of *P. umbonatus*, having a subacute periphery, were not observed. A comparison of the Mediterranean variant with Reuss's specimens might show that it is a different species. It does not occur in the surface sediments but is found in varying abundances in all the cores except Cores 184, 195, 196, and 200. With three exceptions (Core 193, 9.5 cm.; 197, 149.5 cm.; 191, 279.5 cm.) it occurs deeper than 350 cm. in the core sections.

Rosalina aff. **R. columbiensis** (Cushman)
(Plate 3, figures 35, 36)

This is one of the most common species of *Rosalina* in the Mediterranean samples, especially in the displaced faunas of the cores. It may be referrable to several (synonymous) species described from this area but on account of the lack of adequate illustrations and descriptions of these a precise designation cannot be given without reviewing the types. The species is very similar to *R. columbiensis* (Cushman, 1925, p. 43, pl. 6, fig. 13 — *Discorbis*) but differs from it in the more sharply angled periphery and less inflated chambers. Specimens are found at eight stations from 51—201 m., 338 m., and 3499 m. (up to 1 %, 33 % at

3499 m.) and at all stations showing displacement. It occurs in Cores 188, 191—196, and 199 (most abundantly in Cores 192, 194), in all cases associated with displaced faunas.

Rosalina globularis bradyi (Cushman)

(Plate 3, figures 37, 38)

Discorbis globularis d'Orbigny var. *bradyi* Cushman, 1915, U. S. Nat. Mus. Bull. 71, pt. 5, p. 12, pl. 8, fig. 1.

Mediterranean specimens are identical to Cushman's types. Whether or not this form is related to *R. globularis* is difficult to tell. In discussing the identity of *R. globularis* with various workers on the Foraminifera, I have encountered no unanimity of opinion. Some believe that Cushman's variety is *R. globularis* s. s., but it differs from d'Orbigny's illustrations of this species in having a narrow keel, being finely perforate on the ventral side, and in usually having non-depressed, limbate sutures on the dorsal side. Specimens from the vicinity of Ireland appear close to d'Orbigny's figured species except that they, too, have a finely perforate ventral side. Associated with these, and apparently a variant form, are specimens referrable to Cushman's variety. If, therefore, an examination of d'Orbigny's types reveals a form with a finely perforate ventral side it may be that Cushman's variety is in reality a variant form of *R. globularis* and is, therefore, synonymous with it. All the Mediterranean specimens seem to be referrable to the keeled form.

R. globularis bradyi is found at seven stations from bay—143 m. (up to 1 %), at two stations showing displacement, and in Cores 188, 192, 194—196, and 200, in scattered samples associated with displaced faunas.

Rosalina obtusa d'Orbigny

(Plate 3, figures 33, 34, 39)

Rosalina obtusa d'Orbigny, 1846, Foram. Foss. Bass. Tert. Vienne, p. 179, pl. 11, figs. 4—6.

This species is found at twenty stations from bay—996 m. (up to 9 %) mostly shoaler than 338 m., at four stations showing displacement, and in scattered samples in Cores 187, 188, 191—196, 199, and 200, associated with displaced faunas.

Rosalina suezensis (Said)

(Plate 3, figures 40, 41)

Discorbis suezensis Said, 1949, Cushman Lab. Foram. Res., Spec. Publ. 26, p. 36, pl. 3, fig. 34.

The Mediterranean specimens are identical to Said's holotype and topotypes. The species is reported in the North Atlantic shallower than 850 m. It is found at nine stations from 71—567 m. (up to 1 %) mostly shallower than 256 m., at two stations showing displacement, and in Cores 192 and 200 associated with displaced faunas.

Rosalina spp.

There are many species of *Rosalina* in the surface sediments and cores which have not been differentiated because of their rare occurrence. The genus appears to be almost always confined to depths of less than 1000 m., in most cases considerably less. For this reason *Rosalina* spp. in the cores are interpreted as having been displaced from relatively shallow water. This is usually substantiated by the presence of known shallow species. *Rosalina* spp. are found at three stations from 51—115 m. (up to 1 %), at one station showing displacement, and in Cores 188, 191, 192, 194—196, and 200, associated with displaced faunas, being very abundant in Cores 192 and 194.

Valvulineria complanata (d'Orbigny)

(Plate 3, figures 42, 43, 44)

Rosalina complanata d'Orbigny, 1846, Foram. Foss. Bass. Tert. Vienne, p. 175, pl. 10, figs. 13—15.

? *Discorbina bradyana* Fornasini, 1900, Mem. R. Accad. Sci. Istit. Bologna, ser. 5, vol. 8 (1899—1900), p. 393, text fig. 43.

Mediterranean specimens are identical with those seen from the Miocene of Baden, Austria. Writers on Mediterranean Foraminifera refer similar specimens to *V. bradyana* and this species may be synonymous although Fornasini's figured specimens are not identical. *V. complanata* is found in thirteen stations from 51—799 m. (up to 2 %), and in Cores 184, 188—190, 192, 194, 197, 199, and 200.

Family ROTALIIDAE

Rotalia granulata (di Napoli Alliata)

(Plate 4, figures 1, 2)

Eponides frigidus Cushman var. *granulatus* di Napoli Alliata, 1952, Riv. Ital. Pal. Strat., vol. 58, no. 3, p. 9, pl. 5, figs. 3, 3 a, 3 b.

Eastern Mediterranean specimens resemble topotypes from the yellow sands of the upper Pliocene Castell' Arquato, Italy. They differ somewhat in being more convex on the ventral side. The tests have a thick, narrow keel and the umbilical region is filled with a mass of pillars of various sizes and shapes.

The species is found at eight stations from bay—143 m. (up to 4 %) and occurs rarely in Core 200.

Streblus beccarii (Linné) and vars.

»*Cornu hammonis*» Plancus, 1739, Conch, Min., p. 8, pl. 1, fig. 1.

»*Ammonia unita*» Gualtieri, 1742, Index Test., pl. 19, figs. H, I.

Nautilus beccarii Linné, 1767, Syst. Nat., ed. 12, p. 1162.

The generic name *Streblus* Fischer 1817 has been used here with some trepidation, since I am by no means sure that it is the correct one. There appears to be good evidence that *Ammonia* Brunnich 1771 has priority. Since, however, the available information is at second hand (*vide* Frizzell and Keen, 1949; Smout, 1954) this name has not been used here. Specimens from Rimini, Italy, show considerable variation in the amount of limbation of sutures, presence or character of ventral plugs, and number of chambers in the last-formed whorl. It is possible that more than one species is included in the group, though specimens referred to *S. beccarii* in various parts of the world show a similar type of variation. Some of these have been named but perhaps such formal differentiation will prove biologically unsound. The naming of varieties, or infrasubspecies, is often defended by the paleontologist since it has a useful purpose in stratigraphic work but in most cases the forms so named are in reality species or subspecies and not in any sense varieties. In the present case there is no good reason for differentiation, either biologically, stratigraphically, or apparently ecologically. The species is found at seven stations from bay—179 m. (up to 7 %), at three stations showing displacement, and in scattered samples in Cores 184, 188, 192, 194, 196, and 198, associated with displaced faunas.

Family ELPHIDIIDAE

Elphidium advena (Cushman)

(Plate 4, figures 3, 4)

Polystomella advena Cushman, 1922, Publ. 311, Carnegie Instit. Washington, p. 56, pl. 9, figs. 11, 12.

Specimens are larger (max. diam. 0.8 mm.) than those described by Cushman (max. diam. 0.5 mm.). The species is reported in »shallow» water in the North Atlantic and shallower than 115 m. in the eastern Gulf of Mexico. It is found at nine stations from bay—179 m. (up to 2 %) and occurs in Cores 184, 191, 192, 194, 195, 199, and 200, associated with displaced faunas.

Elphidium complanatum (d'Orbigny)

(Plate 4, figure 5)

Polystomella complanata d'Orbigny, 1839, *in* Barker-Webb and Berthelot, Hist. Nat. Iles Canaries, vol. 2, pt. 2, »Foraminifères», p. 129, pl. 2, figs. 35, 36.

This species is reported by Colom (1950, 1952) shallower than 726 m. off the coast of Africa and 105 m. off the coast of Galicia. It is found at thirteen stations from bay—205 m. (up to 7 %) and occurs in Cores 188, 192—194, and 196, associated with displaced faunas.

Elphidium crispum (Linné)

»*Cornu hammonis*» etc., Plancus, 1739, Conch. Min., p. 10, pl. 1, figs. 2 d—f.

»*Nautilus minimus*» etc. Gualtieri, 1742, Index Test. Conch., pl. 19, figs. A, D.

Nautilus crispus Linné, 1758, Syst. Nat., ed. 10, vol. 1, p. 709.

Nautilus macellus Fichtel and Moll, Testacea microscopica, p. 66, var. B, pl. 10, figs. h—k, 1798.

Elphidium nigarense Cushman, 1936, Contr. Cushman Lab. Foram. Res., vol. 12, p. 85, pl. 15, figs. 3 a, b.

This species is very variable. Mediterranean specimens have been subdivided by Cushman (1939) and others, part being referred to *E. macellum*. There seems no logical way to do this since there is a complete series of variations in number of chambers, compression of test, character of umbo, etc. A study was made of specimens from Rimini, Italy, presumably the type locality of *E. crispum* (Cushman, 1939, p. 51). The beach sands at Rimini seems to contain a mixture of Recent forms and fossil forms derived from nearby Pliocene and Pleisticene outcrops. For this reason it may contain species of *Elphidium* from different sources. Since, however, a similar amount of variation, though on a smaller scale, has been observed in other Recent Mediterranean samples, the two species, *crispum* and *macellum*, are believed to be synonymous. Also included in the population counts of *E. crispum* are specimens referrable to *E. nigarense* whose only claim to distinction is a lesser number of chambers than is typically present. Such specimens also occur in the Rimini complex. *E. crispum* is reported by Colom (1950) off the coast of Africa to a depth of 726 m. It is found at fourteen stations from bay—338 m. (up to 7 %), at two stations showing displacement, and in Cores 192, 194, 196, 198, and 199, associated with displaced faunas.

Elphidium granosum (d'Orbigny)

(Plate 4, figures 10, 11)

Nonionina granosa d'Orbigny, 1846, Foram. Foss. Bass. Tert. Vienne, p. 110, pl. 5, figs. 19. 20.

Elphidium lidoense Cushman, 1936, Contr. Cushman Lab. Foram. Res., vol. 12, pt. 4, p. 86, pl. 15, figs. 6 a, b.

Mediterranean specimens are similar to those from Miocene of the Vienna Basin except that they are smaller (max. diam. 0.43 mm.). The types of Cushman's species, *E. lidoense*, are identical. *E. granosum* may be the species referred by some workers in the Mediterranean area to *E. decipiens* (Costa), whose original figure shows a keeled test with 13 chambers in the final whorl. For a comparison of *E. granosum* with *E. minimum* (Seguenza) see the discussion of the latter species. According to Bramlette (personal communication) *E. granosum* has a radiate wall structure. This species is found at nine stations from 51—201 m. (up to 6 %), mostly shoaler than 106 m., and in Cores 192 and 199 associated with displaced faunas.

Elphidium cf. **E. minimum** (Seguenza)
(Plate 4, figures 8, 9)

The Recent specimens appear to have a less acutely angled periphery than Seguenza's (1880, p. 333, pl. 17, figs. 38, 38 a — *Polystomella*) figured specimen. They resemble *E. granosum* but have non-depressed sutures, and, therefore, a non-lobulate periphery and in most cases a simple rather than multiple umbo. According to Bramlette (personal communication) the wall has a radiate structure. This species is found at nine stations from bay-179 m. (up to 5 %), at three stations showing displacement, and in Cores 186, 188, 194, and 196, in occasional samples associated with displaced faunas.

Elphidium pulvereum Todd
(Plate 4, figure 6)

Elphidium pulvereum Todd, 1958, Rep'ts. Swedish Deep-Sea Exped., vol. VIII, no. 3, p. 201, pl. 1, figs. 19, 20.

Eastern Mediterranean specimens are identical with l. cestern Mediterranean specimens kindly sent me by Miss Ruth Todd. The species is found at three stations from 106—201 m. (less than 1 %), at three stations showing displacement, and in Cores 188, 190—196, 198, and 199, associated with displaced faunas. The most frequent occurrences are in Cores 192, 194 and 195; in the other cores they are scattered.

Elphidium spp.

Elphidium spp. includes all undesignated species found in the present study. Most of these occur so rarely that it would be impractical to list them separately. Since the genus has, without exception, a shallow distribution its occurrence even as a unit is valuable. In a core it denotes the presence of displaced shallow material. *Elphidium* spp. are found at one station at 287 m. (0.3 %), at one station showing displacement, and in Cores 184, 188, 191—198, and 200, associated with displaced faunas.

Parrellina verriculata (Brady)
(Plate 4, figure 7)

Polystomella verriculata Brady, 1881, Quart. Journ. Micr. Sci., vol. 21, p. 66; 1884, Rep't. Voy. CHALLENGER, Zool., vol. 9, p. 738, pl. 110, figs. 12 a, b.

This species is incorrectly listed as *Elphidium verriculatum* in Tables 3 and 15. Tt is found at twelve stations from 51—201 m. (up to 3 %), at one station showing displacement, and in Cores 192, 194, and 195 associated with displaced faunas.

Family CASSIDULINIDAE

Cassidulina carinata Silvestri
(Plate 4, figure 15)

Cassidulina laevigata d'Orbigny var. *carinata* Silvestri, 1896, Accad. Pont. Nuovi Lincei, Mem. 12, p. 104, pl. 2, fig. 10 (*C. laevigata* in expl. of pl.).

This is a common species in the area being found at twenty-five stations from 51—996 m. (up to 14 %) with relatively high frequencies to a depth of 567 m., at six stations showing displacement, and in all the cores except Core 197.

Cassidulina crassa d'Orbigny
(Plate 4, figure 12)

Cassidulina crassa d'Orbigny, 1839, Voy. Amér. Mérid., vol. 5, pt. 5, »Foraminifères», p. 56, pl. 7 figs. 18—20; Brady, 1884, Rep't. Voy. CHALLENGER, Zool., vol. 9, p. 429, pl. 54, fig. 5.

Brady's interpretation of this species is the one followed here. It is found at twenty-six stations from 104—1378 m. (up to 7 %), at six stations showing displacement, and in

Cores 184, 186, 188, 191, 192, 194—197, 199, and 200, being most common in Cores 192 and 194.

Cassidulina cf. **C. oblonga** Reuss

(Plate 4, figure 14)

Marks (1952) says that Reuss's (1850, p. 376, pl. 48, figs. 5, 6) species is probably synonymous with *C. crassa* (d'Orbigny). Inasmuch as Brady's interpretation of *C. crassa* is followed here the present species is tentatively referred to *C. oblonga*. Mediterranean specimens are larger than those described by Reuss, reaching a length of *ca.* 0.36 mm., and the sutures are non-depressed. Similar specimens from the Miocene of Baden in the Vienna Basin, presumably referrable to *C. oblonga*, are about the same size as the Recent form but have a larger tooth.

The species is found at twenty-three stations from 51—996 m. (up to 9 %) mostly shallower than 384 m., at six stations showing displacement, and in Cores 184, 187, 188, 191, 192, 194, 195, 197, 199, and 200, mostly associated with displaced faunas (exceptions are occasional single specimens).

Cassidulina cf. **C. sicula** Seguenza

(Plate 4, figures 16, 17)

Mediterranean specimens are smaller (max. diam. 0.3 mm.) than Seguenza's (1862, pp. 111, 125, pl. 1, figs. 7, 7 a) (0.6 mm.). In other respects they are similar. The most outstanding characteristic of the species is the lobulation of the periphery, an unusual feature in a keeled form. It is not found in the surface sediments but occurs in varying abundance in all the cores except Cores 184 and 198.

Cassidulina subglobosa Brady

(Plate 4, figure 13)

Cassidulina subglobosa Brady, 1881, Quart. Journ. Micr. Sci., vol. 21, pl. 30 (60); 1884, Rep't. Voy. CHALLENGER, Zool., vol. 9, p. 430, pl. 54, figs. 17 a—c.

This species does not reach a very large size in Mediterranean samples, the maximum diameter being about 0.36 mm. It has been widely reported from the North Atlantic at all depths to 5532 m. It is found at ten stations from 179—1016 m. (up to 2 %), at two stations showing displacement, and in Cores 191—194, 197, and 200, mostly associated with displaced faunas.

Cassidulinoides tenuis Phleger and Parker

(Plate 4, figures 18, 19)

Cassidulinoides tenuis Phleger and Parker, 1951, Geol. Soc. America, Mem. 46, pt. 2, p. 27, pl. 14, figs. 14 a, b, 15—17.

Mediterranean specimens are identical with those from the Gulf of Mexico, reported chiefly from 255—1100 m. In view of this it seems strange that the species has not been observed in the North Atlantic. It is not found in the surface sediments but occurs in Cores 186, 189—198, usually rarely but occasionally in great abundance.

Virgulina complanata Egger

(Plate 4, figure 20)

Virgulina schreibersiana Czjzek var. *complanata* Egger, 1893, Abhandl. k. bay. Akad. Wiss. München, Cl. II, vol. 18, p. 292, pl. 8, figs. 91, 92.

This species is found at one station at 3974 m. (13 %), and in Cores 193, 194, and 197, being very abundant in the lower part of Core 193.

Virgulina mexicana Cushman

(Plate 4, figures 26, 27)

Virgulina mexicana Cushman, 1922, U. S. Nat. Mus., Bull. 104, pt. 3, p. 120, pl. 23, fig. 8.

This species is found at one station at 3974 m. (61 %), at one station showing displacement, and in scattered samples in all the cores except Cores 189, 191, and 197.

Family EPISTOMINIDAE

Epistominella rugosa convexa Parker, n. subsp.

(Plate 4, figures 21, 22, 23)

This subspecies may be distinguished from the typical form by its more convex dorsal side, larger umbo, and less rugose wall especially on the dorsal side. It differs from *E. umbonifera* (Cushman) in having a keel. Maximum diameter 0.32 mm., thickness 0.18 mm.

The holotype (U. S. N. M. P6125) and figured paratypes (U. S. N. M. P6126 a, b) are from ATLANTIS Sta. 4723, Lat. 37° 11′ N, Long. 11° 33.5′ E, at a depth of 567 m.

Although this form appears to be closely related to *E. rugosa*, reported from deeper than 250 m. in the Gulf of Mexico, neither form has been observed in the North Atlantic. *E. rugosa convexa* is found at ten stations from 541—1016 m. (up to 13 %) with highest frequencies from 600—700 m., at two stations showing displacement, and in Cores 186—189, 192, 194, 196 and 199 very occasionally except in Cores 186, 192, and 194 where it is more common.

Siphonina reticulata (Czjzek)

(Plate 4, figure 25)

Rotalina reticulata Czjzek, 1848, Haidinger's Nat. Abhandl., vol. 2, p. 9, pl. 13, figs. 7—9.

This species is found at twenty-one stations from 104—1016 m. (up to 3 %), at three stations showing displacement, and in Cores 194 and 199 (once in each) associated with displaced faunas.

Family CHILOSTOMELLIDAE

Chilostomella mediterranensis Cushman and Todd

(Plate 4, figure 24)

Chilostomella mediterranensis Cushman and Todd, 1949, Contr. Cushman Lab. Foram. Res., vol. 25, pt. 4, p. 92, pl. 15, figs. 25, 26.

This species is found at six stations from 567—1378 m. (up to 2 %), at three stations showing displacement, and in varying abundance in all the cores.

Pullenia bulloides (d'Orbigny)

Nonionina bulloides d'Orbigny, 1826, Ann. Sci. Nat., vol. 7, p. 293, no. 2; 1846, Foram. Foss. Bass. Tert. Vienne, p. 107, pl. 5, figs. 9, 10.

This species is not found in the surface sediments but occurs in scattered samples in Cores 186, 189, 192, 193, 197, and 199.

Pullenia quinqueloba (Reuss)

(Plate 4, figures 32, 33)

Nonionina quinqueloba Reuss, 1851, Zeitschr. deutsch. Geol. Ges., vol. 3, p. 71, pl. 5, fig. 31.

Specimens have four or five chambers in the final whorl, but are otherwise identical. The species is reported from the North Atlantic deeper than 80 m. It is found at fourteen stations from 82—1265 m. (up to 3 %), at three stations showing displacement, and in Cores 184, 188, 191—194, 196, 198, and 200, associated with displaced faunas. This association in the cores seems rather strange in view of the fact that this has always been considered a deep-living species.

Pullenia cf. P. riveroi Bermudez

(Plate 4, figure 31)

As in the case of North Atlantic specimens reported by Phleger *et al.* (1953, p. 47) the Mediterranean specimens most closely resemble that shown by Bermudez (1939, p. 11, pl. 2, figs. 1—6) in his figure 4. The species is not found in the surface sediments but occurs in Cores 184, 188—195, 198, and 199.

Rotamorphina? involuta Parker, n. sp.

(Plate 4, figures 28, 29, 30)

Test of medium size, with rounded periphery, slightly trochoid, almost entirely involute; chambers 5—6 in the final whorl; sutures narrow, slightly curved, slightly depressed; wall smooth, thin, often translucent, with very fine, dense perforations; aperture extending from the umbilicus on the ventral side over onto the dorsal side, with a small ventral flap; maximum length 0.39 mm., width 0.32 mm., thickness 0.18 mm.

The holotype (U. S. N. M. P6127) and figured paratypes (U. S. N. M. P6128 a, b) are from ATLANTIS Sta. 4714, Lat. 32° 30′ N., Long. 15° 49′ E., at a depth of 665 m.

This species has been placed tentatively in the genus *Rotamorphina*. It seems to bear somewhat the same relation to that genus that *Allomorphinella* does to *Allomorphina* except that the involution is not complete. It differs from other species of *Rotamorphina* in the partially involute character and in the aperture which extends over onto the side. It differs from *R. laevigata* (Phleger and Parker) in both these respects, in being more compressed and less circular in outline, and in having the small ventral flap cling more closely to the test.

This species is found at eight stations from 567—996 m. (up to 5 %), at three stations showing displacement, and in Cores 187, 192, 194, and 195, in scattered samples associated with displaced faunas.

Sphaeroidina bulloides d'Orbigny

Sphaeroidina bulloides d'Orbigny, 1826, Ann. Sci. Nat., vol. 7, p. 267, no 1; Modèles, no. 65.

This species is reported from off the northeastern United States deeper than 80 m. (Parker, 1948) and from off Galicia deeper than 215 m. (Colom, 1952). It is found at twenty-four stations from 75—1265 m. (up to 4 %), at six stations showing displacement, and in scattered samples in Cores 184, 188, 192, 194, and 200, associated with displaced faunas.

Family CERATOBULIMINIDAE

Höglundina elegans (d'Orbigny)

»*Hammoniformis trochiformis*» Soldani, 1789—1799, Test., app., pl. 2, fig. R.

Rotalia (*Turbulina*) *elegans* d'Orbigny, 1826, Ann. Sci. Nat., vol. 7, p. 276, no. 54, (not *Rotalia elegans*, *op. cit.*, p. 272, no. 6).

This species is reported deeper than 42 m. in the North Atlantic. It is found at sixteen stations from 82—1265 m. (up to 2 %, once 16 %), at three stations showing displacement, and in Cores 184, 186—188, 192—194, 199, and 200, usually associated with displaced faunas. It is most abundant in Core 184.

Stomatorbina concentrica (Brady)

Pulvinulina concentrica Brady, 1864, Trans. Linn. Soc. Zool., vol. 24, p. 470, pl. 48, fig. 14.

Uchio (1952) places this species in the genus *Mississippina*, believing that the adult form differs from that of species of *Stomatorbina*. He says (p. 198) »— if adult form of *P. concentrica* is not included in *Stomatorbina*, then the genus *Stomatorbina* is valid, but if included, then the genus *Stomatorbina* Doreen 1948 is a synonym of the genus *Mississippina* Howe, 1930.» It seems very likely that the two genera are synonymous but the scarcity of species attributed to them is such that the generic variation cannot be properly understood. This species is reported in the North Atlantic mostly from 27—290 m. It is found at seven stations from 51—143 m. (up to 1 %) but does not occur in the cores.

Family ANOMALINIDAE

Cibicides aff. **C. floridanus** (Cushman)

(Plate 4, figures 36, 37, 38)

This species is common in the eastern Mediterranean and may have been specifically

described, either as Recent or fossil, from this general area. This cannot be determined, however, from the figures and descriptions given and a study of the available types must be made to find out. The species is related here to Cushman's (*Truncatulina floridana* Cushman, 1918, p. 62, pl. 19, fig. 2) species which it resembles. The sutures are not raised as in *C. floridanus* s. s. but specimens from the Gulf of Mexico referred to *C.* aff. *C. floridanus* by Phleger and Parker (1951) and Parker (1954), which show a wide range of variation, include similar forms. Eastern Mediterranean specimens are more umbonate than those of *C. ungerianus* (d'Orbigny) from the Miocene of the Vienna Basin, and are larger, with thicker walls and less clearly defined chambers than those of *P. pseudoungerianus* (Cushman) from the Oligocene Byram marl. Similar ones apparently have been referred by various authors of Mediterranean faunas to these two species.

C. aff. *C. floridanus* is found at twenty stations from 106—2442 m. (up to 10 %), at four stations showing displacement, and in Cores 184, 186—189. 192—194, and 199, often in considerable numbers.

Cibicides kullenbergi Parker

(Plate 4, figures 34, 35, 40)

Cibicides kullenbergi Parker, 1953 *in* Phleger, Parker, and Peirson, Rep'ts. Swedish Deep-Sea Exped. (1947—48), vol. 7, no. 1, p. 49, pl. 11, figs. 7, 8.

Specimens are typical although their tests are usually somewhat smaller than those from the North Atlantic. Included in the population counts are specimens which are atypical in having a narrower keel and slightly more inflated chambers on the involute side. This is a true deep-sea form, reported in the North Atlantic deeper than 2100 m. It is not found in the surface sediment samples but occurs in Cores 186—189, 191—194, and 199, most commonly in Cores 186, 189 and 193.

Cibicides lobatulus (Walker and Jacob)

Nautilus lobatulus Walker and Jacob, 1798, Adams Essays, Kanmacher's ed., p. 642, pl. 14, fig. 36.

The specimens are very variable but show a continuous gradation from those having a low degree of convexity of the involute side to those having a high degree. The latter may be referrable to *C. refulgens* Montfort although none is as convex as his figured specimens. *C. lobatulus* has been widely reported in the North Atlantic. It is found at thirty-five stations from bay—1265 m. (up to 15 %), at six stations showing displacement, and in Cores 191—196 and 199 associated with displaced faunas.

Cibicides wuellerstorfi (Schwager)

(Plate 4, figures 41, 42)

Anomalina wuellerstorfi Schwager, 1866, Novara Exped., Geol. Theil, vol. 2, p. 258, pl. 7, figs. 105, 107.

This species is reported in the North Atlantic deeper than 630 m. It is found at one station at 1016 m. (3 %), and in Cores 184, 186, 193, 199, and 200, in a few scattered samples.

Hyalinea balthica (Schroeter)

(Plate 4, figure 39)

Nautilus balthicus Schroeter, 1783, Einleitung Conch. Kenntn., vol. 1, p. 20, pl. 1, fig. 2.

Hofker (1951) relates *Hyalinea* to *Streblus*, placing both in the Rotaliidae. The genus appears also to have affinities with the Discorbidae. *H. balthica* is reported to a depth of 2981 m. in the North Atlantic. It is found at eighteen stations from 106—799 m. (up to 6 %) most abundantly to 665 m., and in Cores 184, 186—188, 192—194, 199, and 200, usually associated with displaced faunas.

Planulina ariminensis d'Orbigny

(Plate 4, figure 43)

Planulina ariminensis d'Orbigny, 1826, Ann. Sci. Nat., vol. 7, p. 280, no. 1, pl. 14, figs. 1—3.

The specimens found in the eastern Mediterranean (max. diam. 0.83 mm., thickness 0.36 mm.) are somewhat thicker than those from Rimini (max. diam. 0.9 mm., thickness 0.22 mm.). The species is reported in the North Atlantic deeper than 275 m. It is found at twenty-five stations from 106—1016 m., mostly deeper than 200 m. (up to 5 %), at six stations showing displacement, and in scattered samples in Cores 184, 191, 192, 194, and 199, associated with displaced faunas.

Family PLANORBULINIDAE

Gypsina vesicularis (Parker and Jones)

Orbitolina vesicularis Parker and Jones, 1860, Ann. Mag. Nat. Hist., ser. 3, vol. 6, no. 5, p. 31.

This species is reported in the North Atlantic shallower than 143 m. It is found at six stations from 51—143 m. (up to 9 %), but was not observed in the cores.

Planorbulina mediterranensis d'Orbigny

(Plate 4, figure 44)

Planorbulina mediterranensis d'Orbigny, 1826, Ann. Sci. Nat., vol. 7, p. 280, no. 2, pl. 5 (14), figs. 4—6 bis.; Modèles, no. 79.

This species is reported in the North Atlantic mostly shallower than 150 m. It is found at fifteen stations from bay—567 m., mostly less than 256 m. (bay — 13 %; to 100 m. — up to 4 %; deeper — up to 1 %), at three stations showing displacement, and in Cores 188 and 191—193, associated with displaced faunas.

Planktonic Species

Family GLOBIGERINIDAE

Globigerina bulloides d'Orbigny

(Plate 5, figures 1, 2, 3, 4)

Globigerina bulloides d'Orbigny, 1826, Ann. Sci. Nat., vol. 7, p. 277, no. 1; Modèles, no. 76, no. 17 (juv.).

This species is variable, having 4—5 chambers in the final whorl. Small specimens (*Globigerina* sp., pl. 5, fig. 6) are included in the population counts of *G. bulloides* in some of the core samples and may represent a stunted form. One variant which is of particular interest (*vide* pl. 5, fig. 2: left-hand specimen and adjacent one on lower row) has a supplementary process over the aperture. This process is very similar to the »supplementary chambers» seen in *Globigerinita* and may have some connection with the reproductive cycle. Similar »chambers» have been observed in various planktonic species in the Mediterranean, but they usually occur very rarely.

Globigerina digitata Brady

(Plate 5, figure 8)

Globigerina digitata Brady, 1879, Quart. Journ. Micr. Sci., n. ser., vol. 19, p. 286; 1884, Rep't. Voy. CHALLENGER, Zool., vol. 9, p. 599, pl. 80, figs. 6—10 (not pl. 82, figs. 6, 7).

Brady has included (at least) two species in his *G. digitata*. One form is trochoid throughout and should be referred to *Globigerina* (Brady, 1884, pl. 80, figs. 6—10). The other should be referred to *Globigerinella* (*op. cit.*, pl. 82, figs. 6, 7) being planispiral in the adult. The trochoid form is more widespread, occurring in both the Atlantic and Pacific oceans. The planispiral form is reported only from the Pacific and the writer has not observed it elsewhere. The more common, trochoid species is here designated as *Globigerina digi-*

tata. Since the writer is of the opinion that a lectotype should not be chosen without viewing the actual specimens, the specimens figured on pl. 80, figs. 6—10 are here designated as syntypes. It is possible that a study of these at first hand may reveal the presence of more than one species, one in the Pacific and one in the Atlantic. It is more probable that if there is a difference, which is doubtful, it is a subspecific one. The specimens figured on pl. 82, figs. 6, 7 must await study before a new species referred to *Globigerinella* can be erected. It would be preferable for this species to be defined from a complete suite of specimens from which a holotype can be chosen, Brady's specimens being put in the synonymy of this species.

The planispiral species mentioned above does not belong to the genus *Hastigerinella* Cushman, 1927, as stated by Galloway (1933), Bermudez (1952), and others. *Hastigerinella* as defined by Cushman (1927, p. 82) has club-shaped chambers having spines at the ends. The type species is »*Hastigerina digitata*» Rhumbler (1911, p. 202, pl. 37, figs. 9 a, b) (not *Globigerina digitata* Brady, 1879) which was renamed *Hastigerinella rhumbleri* by Galloway (1933). The observed specimens are generically distinct from either of the species figured by Brady and referred by him to *Globigerina digitata*. *Hastigerinella* is most closely related to *Hastigerina* which also has a very thin test wall, with spines on the peripheral areas of the chambers. The latter is planispiral while the former is not. The chief difficulty in putting *Hastigerinella* on a firm taxonomic basis is the difficulty of obtaining specimens. Due to the fragility of the test complete specimens are rare, if not completely lacking, in the bottom sediments. In the plankton itself specimens are exceedingly rare (J. S. Bradshaw, personal communication).

G. digitata occurs in both sediment and core samples in the Mediterranean. Even the juveniles can be easily identified as they show the typical flaring aperture though they have not the elongate chambers seen in the adults.

Globigerina eggeri Rhumbler

(Plate 5, figures 5, 7)

Globigerina eggeri Rhumbler, 1900, Nordische Plankton, pt. 14, Foraminiferen, p. 19, text figs. 20 a—c.

The Mediterranean specimens are smaller than those of the Atlantic and Pacific oceans, especially in the warmer portions, reaching a maximum diameter of 0.50 mm. In other respects they are typical. In the core sections that appear to reflect colder climates *G. eggeri* usually has a thicker test (pl. 5, fig. 5) than in the sections reflecting warmer periods (pl. 5, fig. 7). In some core samples the species has a very high frequency. These »floods» apparently bear no relation to climatic conditions, occurring in both »cold» and »warm» periods. Kullenberg (1952) related them to reduced salinity conditions caused by the »pluvial» or glacial times but if this were true they should occur only in the cold periods.

Globigerina inflata d'Orbigny

(Plate 6, figure 3)

Globigerina inflata d'Orbigny, 1839, in Barker-Webb and Berthelot, Hist. Nat. Iles Canaries, vol. 2, pt. 2, »Foraminifères», p. 134, pl. 2, figs. 7—9.

The Mediterranean specimens are variable, as are those from the vicinity of the Canary Islands, in the character of the wall which may be smooth or somewhat rugose and in the flatness of the dorsal side, which varies from flat to convex. These variations can be seen in the figured specimens. *Globorotalia oscitans* Todd may represent one of them. It has not been recognized here as a separate species.

Globigerina pachyderma (Ehrenberg)

(Plate 5, figure 9)

Aristerospira pachyderma Ehrenberg, 1861, Monats. k. preuss. Ak. Wiss. Berlin, p. 303; 1872 (1873), Abhandl. Ak. k. Wiss. Berlin, pl. 1, fig. 4.

This species is sometimes difficult to separate from the thick-shelled type of *G. eggeri* which is found in the core sections reflecting cold intervals. An attempt has been made to keep to a very rigid interpretation of *G. pachyderma*, including doubtful specimens in the population counts of *G. eggeri*, since the latter appears to be less diagnostic of temperature changes in this area. There is no doubt that the species are distinct but here, as in other cases, the line is sometimes difficult to draw.

Globigerina quinqueloba Natland

(Plate 6, figure 1)

Globigerina quinqueloba Natland, 1938, Bull. Scripps Instit. Ocean., Techn. Ser., vol. 4, no. 5, p. 149, pl. 6, figs. 7 a—c.

This species occurs in its typical form in the Mediterranean. Frequently associated with it are specimens (pl. 6, fig. 2) which appear to be similar except for the presence of a supplementary process over the aperture similar to that seen in *Globigerinita*. Since such a process has been observed on specimens of many species, there is some question of its generic or specific significance. Such specimens are included in the populations counts of *Globigerina quinqueloba*.

Globigerina radians Egger

(Plate 5, figure 10)

Globigerina radians Egger, 1895, Abhandl. k. bay. Akad. Wiss., München, Cl. II, vol. 18, pt. 2 (1893), p. 362, pl. 13, figs. 22—24. — Rhumbler, 1911, Ergebn. Plankton-Exped. Humboldt Stift., vol. 3 (1909), p. 148, pl. 29, figs. 2—4.

Rhumbler's reference is included in the synonymy because he more accurately figures this species, although Egger's figures are sufficiently similar to make the identification a plausible one. The test of *G. radians* is more compressed than that of *G. quinqueloba* and the chambers more elongate giving a more lobulate peripheral outline. There is frequently a long lobe-like extension from the last-formed chamber over the umbilical area. Similar specimens have been observed in material from the Pacific, The maximum diameter of the eastern Mediterranean specimens is *ca.* 0.34 mm. but most are somewhat smaller.

The species referred to »*Globigerina* sp.» in the northeastern Gulf of Mexico (Parker, 1954, p. 476) appears to be synonymous. I pointed out that this species resembled Rhumbler's (1911, pl. 30, figs. 1—6) »*G. lamellosa* Terquem» but it seems more probable that Rhumbler's species should be referred to *G. quinqueloba* since his specimens are less compressed and lobulate than *G. radians*.

Globigerinella aequilateralis (Brady)

(Plate 6, figures 5, 6)

Globigerina aequilateralis Brady, 1879, Quart. Journ. Micr. Sci., vol. 19, p. 71; 1884, Rep't. Voy. CHALLENGER, Zool., vol. 9, p. 609, pl. 80, figs. 18—21.

The genus *Globigerinella* is closely related to *Globigerina* differing from the latter in becoming planispiral in the adult. Intermediate forms sometimes make generic identification difficult. *Globigerinella aequilateralis* in the Mediterranean, however, is usually planispiral in the adult form. The young forms are globigerine (*vide* pl. 6, fig. 5) but may be differentiated from similar specimens of *Globigerina bulloides* by the low, arched aperture. *Globigerinella aequilateralis* appears to be a reliable indicator of the warmer intervals reflected in the core sections.

Globigerinita glutinata (Egger)

Globigerina glutinata Egger, 1895, Abhandl. bay. Akad. Wiss., München, Cl. II, vol. 18, pt. 2 (1893), p. 371, pl. 13, figs. 19—21. — Rhumbler, 1911, Ergebn. Plankton-Exped. Humboldt. Stift., vol. 3 (1909), p. 148, pl. 29, figs. 14—26.

Mediterranean specimens are similar to those illustrated by Phleger *et al.* (1953, pl. 2, figs. 12—15). The supplementary process or »chamber» which covers the aperture is similar to that seen in many species as an occasional feature. In *G. glutinata* it is much more commonly present although by no means invariably so. It would be interesting to know what proportion of the specimens of related fossil species have this supplementary process. Here again, as in the case of *Globigerinella*, is a genus which is narrowly separated from *Globigerina*. As pointed out by Phleger *et al.* (*op. cit.*, p. 16), specimens are sometimes seen with a second aperture on the dorsal side. This in turn relates the genus to *Globigerinoides*. The planktonic genera are many of them so closely related that in a specific case it is often difficult to give a precise generic designation. For this reason some of the presently accepted genera might more appropriately be designated as subgenera.

Globigerinoides conglobata (Brady)

(Plate 6, figure 17)

Globigerina conglobata Brady, 1879, Quart. Journ. Micr. Sci., vol. 19, p. 72; 1884, Rep't. Voy CHALLENGER, Zool., vol. 9, p. 603, pl. 80, figs. 1—5; pl. 82, fig. 5.

Only typical adult specimens have been included in the population counts. Specimens which may be juvenile *G. conglobata* are included with »*G. rubra*, etc.» (pl. 6, fig. 16). The argument against this is that these small forms are almost always present whereas adult *G. conglobata* is comparatively rare. A further discussion of these small forms is given under *G. rubra*, etc.

One of the figured specimens (pl. 6, fig. 17, right-hand specimen) has a supplementary process over the aperture similar to that seen in *Globigerinita*. As previously mentioned this feature occurs occasionally in many species and it is suggested that it may have some connection with the reproductive process.

G. conglobata is rare in the surface sediment samples but occurs in the cores usually in sections reflecting warmer periods.

Globigerinoides rubra (d'Orbigny)

(Plate 6, figure 12)

Globigerina rubra d'Orbigny, 1839, *in* De la Sagra, Hist. Phys. Pol. Nat. Cuba, »Foraminifères», p. 82, pl. 4, figs. 12—14.

At least three different species may be included in the population counts of »*G. rubra*, etc.» The first is typical *G. rubra* which has a smoother test than the following species and when present usually has at least some specimens showing a pink color. The second form (pl. 6, fig. 14) is referred by authors to several species which may or may not be synonymous. The best illustrated of these and the safest identification without seeing the types is *G. pyramidalis* (van den Broeck) (1876, p. 127, pl. 3, figs. 9, 10). Other possible designations are *G. elongata* (d'Orbigny) and *G. helicina* (d'Orbigny). The third species (pl. 6, fig. 16) is a very compact form which either represents juvenile *G. conglobata* or a species which cannot be easily differentiated from such juveniles. Possible identifications are *G. gomitula* (Seguenza) and *G. cyclostoma* (Galloway and Wissler). It is possible, however, that these two species may represent young forms of *G. rubra* or »*G. pyramidalis*».

Only *G. rubra* can be safely used for interpreting climatic conditions reflected in the cores as it is apparently found only in the warmest periods. Its presence is indicated in the distribution tables. All three species are found in the surface sediments. Occasional specimens possibly referrable to »*Globigerina* ? *helicina* d'Orbigny var. *aculeata*» Silvestri are found in the cores.

Globigerinoides sacculifera (Brady)

(Plate 6, figure 4)

Globigerina sacculifera Brady, 1877, Geol. Mag., vol. 4, p. 535; 1879, Quart. Journ. Micr. Sci., vol. 19, p. 73; 1884, Rep't. Voy. CHALLENGER, Zool., vol. 9, p. 604, pl. 80, figs. 11—17; pl. 82, fig. 4.

This species includes specimens similar to those referred by various authors to *G. triloba* (Reuss) (*vide* pl. 6, fig. 4, lower specimens) but they appear to be within the normal variation of *G. sacculifera*. This species appears to be diagnostic of warmer periods in the cores.

Globigerinoides tenella Parker, n. sp.

(Plate 6, figures 7, 8, 9, 10, 11)

Test small for the genus, ratio of width to length *ca.* 6: 7; chambers rather rapidly increasing in size as added, four in the final whorl, rounded in outline; sutures depressed; wall roughened by dense, short spines; ventral aperture large, almost circular in outline, dorsal aperture small, narrow, at inner inner side of the final chamber, the earlier dorsal apertures in most cases apparently filled by shell material. Maximum diameter *ca.* 0.36 mm.

The holotype (U. S. N. M. P6129) and figured paratypes (U. S. N. M. P6130 a—d) are from ATLANTIS Sta. 4711, Lat. 34° 58′ N., Long. 19° 24′ E., at a depth of 3309 m.

Most specimens, including those at the type locality, are smaller in diameter than 0.36 mm. The test is shaped like that of *Globigerina bulloides* but differs in its smaller size, more sharply spinose test, and the presence of the dorsal aperture. *G. tenella* differs from *G. rubra* in its smaller size, less rounded outline, more spinose test, and smaller number of apertures. The specimens of this species were first thought to represent juvenile forms of some larger species of *Globigerinoides* but in tracing back the adult forms of known species to the juvenile stages they were isolated and found to be distinct.

Inadvertently in a few cases specimens of *Globigerina* sp. (pl. 5, fig. 6) were included in the population counts of *Globigerinoides tenella* in the cores. This is believed to have happened so occasionally as not to materially effect the population counts given in the tables. In general, the species is more common in the warmer periods of the cores. It is also found in the surface sediments.

Hastigerina pelagica (d'Orbigny)

(Plate 6, figure 15)

Nonionina pelagica d'Orbigny, 1839, Foram. Amér. Mérid., p. 27, pl. 3, figs. 13, 14.

This species occurs in its typical form. Occasional specimens are much more compressed and evolute than is typical, with an increased number of chambers. It is suggested that this represents a different stage in the life cycle of the species. The species occurs in the warmer periods in the cores, and in the surface sediments.

Orbulina universa d'Orbigny

(Plate 6, figure 13)

Orbulina universa d'Orbigny, 1839, *in* De la Sagra, Hist. Phys. Pol. Nat. Cuba, »Foraminifères», p. 3, pl. 1, fig. 1.

This species occurs in its typical form. There are also many atypical forms, some of which are illustrated. Many bilobate specimens are found showing that great care must be taken in using such species as »*Orbulina bilobata*» d'Orbigny in stratigraphic work. It is believed that the complex of specimens containing bilobate, multilobate and single-chambered specimens may be referred to one species since the test walls are similar in all forms. It should be mentioned, however, that in many core samples only the single-chambered forms are seen.

Family GLOBOROTALIIDAE

Globorotalia punctulata (d'Orbigny)

Globigerina punctulata d'Orbigny, 1826, (nom. nud.), Ann. Sci. Nat., vol. 7, no. 8. — Fornasini, 1898, Pal. Ital., vol. 4, p. 210, text fig. 5.

Deshayes (1832, p. 170) describes a species, *Globigerina puncticulata*, in the synonymy of which he places d'Orbigny species (*G. punctulata*) of 1826, which in 1832 was a nomen nudum. Deshayes' species *G. puncticulata* is a valid one. This, in the writer's opinion, has no bearing on the legality of the name »*Globigerina punctulata*» d'Orbigny, 1898, which was established when Fornasini published d'Orbigny's figures from the »Planches inédites». The writer believes that Ellis and Messina in their »Catalogue of Foraminifera» erred in combining the two species. That they are not synonymous is obvious from Deshayes' description which is of a small globigerine form »composée de trois ou quatres globules bien séparés des un des autres» and having a maximum diameter of 0.2 mm.

Globorotalia punctulata is absent from the eastern Mediterranean surface sediments and occurs only once in Core 197 at a depth of 609.5 cm. It is suggested that the specimens at Rimini, the type locality, are probably derived from the nearby Tertiary outcrops. Phleger *et al.* (p. 20, pl. 4, figs. 8—12) give a list of synonymous species and figure specimens which are identical with the specimens found in Core 197.

Globorotalia scitula (Brady)

Pulvinulina scitula Brady, 1882, Proc. Roy. Soc. Edinburgh, vol. 11, p. 716.

Pulvinulina patagonica Brady, 1884, (not *Rotalina patagonica* d'Orbigny, 1839), Rep't. Voy. CHALLENGER, Zool., vol. 9, p. 693, pl. 103, fig. 7.

This species occurs in the Mediterranean surface sediments and cores in its typical form. It is more common in the cores in the sections reflecting cooler periods.

Globorotalia truncatulinoides (d'Orbigny)

Rotalia truncatulinoides d'Orbigny, 1839, *in* Barker-Webb and Berthelot, Hist. Nat. Iles Canaries, vol. 2, pt. 2, »Foraminifères», p. 132, pl. 2, figs. 25—27.

This species occurs in its typical form in surface sediments and cores. It shows changes of coiling direction in the cores as shown in Figure 6. These changes are discussed in the section on the planktonic Foraminifera in the cores. Specimens are rare in the surface sediments but occur frequently in the cores, especially in the lower sections.

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TABLES

	AEGEAN																						E. MED.	
STATION	4662A	4676	4661	4658	4667	4657A	4649A	4654A	4668	4654B	4652	BS21	BS20	4657B	BS29	4648	4647	4651	4681	4711				
DEPTH IN METERS	51	71	75	82	86	104	106	115	117	143	201	205	210	256	287	338	366	384	1285	1330				
Globigerina bulloides	25	13		10	21	35	4	18	11	19	30	34	35	33	20	22	19	29	14	17				
digitata		8		1				1					2						3	2				
eggeri				2	4	4		4		10	21	13	6	15	12	10	7	9	6	8				
inflata	13		1		4	3.6		2	1	2		2				1	2	.4	.2	4				
pachyderma																1	3	.4	.5	2				
quinqueloba		4	1	2		3.6				2	3	3	1	.4	.5	8	3	1	.2	2				
radians															.5					1				
Globigerinella aequilateralis						2		3		2	3	3	4	2	1	2	2	3	4	5				
Globigerinita glutinata					4	2		1		2	1	1	2	.4	1	1	.4	2	.7	6				
Globigerinoides conglobata																				.1				
rubra, etc.	62	71	93	81	51	44	91	67	72	54	35	43	44	46	61	53	56	50	56	37				
sacculifera			1		8	1	1	2	11	4	2		2	1	1	1	6	1	7	4				
tenella		4	3	4	8	5	2	3	2	3	.4	3	1	.4	2		.4	3	4	3				
Globorotalia scitula																				4				
truncatulinoides																	.4			1				
Hastigerina pelagica										1									.5					
Orbulina universa			1			1	.6	.4	2	2	2		1	1	1	1	.4	.4	4	4				
% of total fauna	3	6	12	14	7	21	30	51	18	25	32	20	20	41	36	25	76	57	99+	99+				

TABLE 2. Distribution of planktonic species in selected surface sediment samples in per cent of total planktonic population.

STATION	BS 32	4662A	4666	4661	4658	4667	4657A	4649A	4654A	4668	4654B	4721A	4652	BS21A	BS20	4657B	BS29	4648	4647	4657	4718	4694	4723	4687	4685	4644	4660	4714	4656	4713	4654	4686	4702	4650	4670	4671	4693	4649	4688	4716	4705	4673	4678	4633	4689	4698	4701	4681	4710	4711	4708	4676	4691	4665
DEPTH IN METERS	Bay	51	71	75	82	86	104	106	115	117	143	179	201	205	210	256	287	338	366	384	541	567	631	647	658	665	680	684	731	746	799	799	859	996	1016	1073	1265	1312	1378	1788	1844	1862	2358	2442	2738	2760	2852	3241	3309	3499	3974	462	552	850	1064	1102	1331	1587
Angulogerina angulosa												2	.6					.4	.7		1		4							.4																											
Articulina tubulosa & vars.																																																					.5			5		.7
Asterigerinata mamilla	4	13	4	38	5	2	3	.5	16	11	9	4																	.5			.5				.6													13	20				1		1	
Astrononion stelligerum		2	.3	1	1		.3		.5	.4	.6													.3																														5				1		.5
Bigenerina nodosaria			.6	.6	2	2	.2	6				.5	1	1	2	5	3	.7	2	.3	4		2		1	.2				3		.5						.3																.3					
Biloculinella labiata								.3			1						.3	.4		.3	1	3	.8	3	1		.3	.6	.5	3	3	1	.5	1	.3	2																.5					
Bolivina albatrossi																						.4	.4						1								4			5															2	.3		2	1	
attica				.2	1	.5	.7			.6				2				.4				1																2																.3	4		7	.5	
catanensis			5		4	8	3	8		.3			2	2	8	4	2	2		5		2															.3																					.5	
Streblus beccarii & vars.	2	7	4		2	5	.5					2																																														7
Textularia calva	2	3	4	3	3	2	2	5	3	2	5	2	5	2	2	2	2	2	2	2.3			1																																.3		.6		1
conica		.4	1	2	.3	.3		.3	2	.4	3		2			.5	1	2	.3	1	.2	1	1																																.4				
sagittula		1	.3	7	4	2	5	2	2	9	6		5	2	2	.3	2	.4	2										.4																													
Uvigerina auberiana												1	2			1	3	3	5	9		3	.6	.6		3	.5	7	1																								.5					1
mediterranea					.6	.3	3	10	.5			5	11	21	22	19	9	16	13	26	35	8	22	37	33	14	28	5	41	3	16	17	48	3	7	13	19	7	3		2				25	6		6					.3	4		.4		.2
peregrina																																				4																22	9	14	10	4	1
Valvulineria complanata		.2	2		.3	1	.3			.4				2	2	.3	.3							.3	.2					.5																									2		5	
Virgulina complanata																																																									
mexicana																																																									
Miscellaneous spp.	5	4	3	3	3	6	5	1	6	12	7	5	2	2	3	1	6	4	5	1	7	15	8	4	4	3	1	8	4	10	6	6	4	6	4	8	2	16	3	7	6		4	4					3			13					.2
% of total fauna	100	97	94	88	86	93	79	70	49	82	75	38	68	80	80	59	64	75	24	43	2	40	16	46	36	85	79	6	8	13	3	12	11	6	44	3	5	2	12	1	<1	<1	1	<1	<1	<1	<1	<1	<1	1	<1	<1	1	11	1	2	15	9	7	7

TABLE 3. Distribution of benthonic Foraminifera in surface sediment samples in per cent of total benthonic population.
Stations with large displaced faunas are in section at right.

CORE 184

SAMPLE	1	2	7	19	21	22	23	25	29	34	35	37	41	46	48	49	54	58
DISTANCE FROM TOP (CM)	0.5 - 1	9.5 - 10	59.5 - 60	179.5 - 180	199.5 - 200	209.5 - 210	219.5 - 220	239.5 - 240	279.5 - 280	329.5 - 330	339.5 - 340	359.5 - 360	399.5 - 400	449.5 - 450	469.5 - 470	479.5 - 480	529.5 - 530	569.5 - 570
PLANKTONIC POPULATION (%)	390	1200	100	70	70	100	200	70	70	560	430	400	230	310	1400	1000	1500	620
Globigerina bulloides	1	1	1	6	1	1		6	3	3	6	3	1	4	4	3	4	3
digitata	3	.6	1				.5		1									
eggeri	15	10	7	12	7	1	.5		12	5	16	12	10	12	10	8	26	24
inflata					3		5			2	2	1	2	.3	1			
pachyderma										1	6	10	9	8	7	14	7	3
quinqueloba							.5			.5	3	4	2	9		2	7	16
radians	.3									.7	.7	1		.3				
Globigerinella aequilateralis	4	6	6	1	4	5	4											
Globigerinita glutinata		.3	3		14	11	6	14	12	3	3	2	2	2	2	4	1	1
Globigerinoides conglobata										.5								
rubra, etc.	71	65	77	57	43	75	50	78	69	84	56	58	61	57	70	61	44	49
(typical G. rubra present)	x	x	x	x	x	x	x	x	x				x	x				x
sacculifera	2	8		23	27	6	27	1										
tenella	1	5	1					1										

CORE 184

SAMPLE	1	2	7	19	21	22	23	25	29	34	35	37	41	46	48	49	54	58
DISTANCE FROM TOP (CM)	0.5-1	9.5-10	59.5-60	179.5-180	199.5-200	209.5-210	219.5-220	239.5-240	279.5-280	329.5-330	339.5-340	359.5-360	399.5-400	449.5-450	469.5-470	479.5-480	529.5-530	569.5-570
PLANKTONIC POPULATION (%)	390	1200	100	70	70	100	200	70	70	560	430	400	230	310	1400	1000	1500	620
Globigerina bulloides	1	1	1	6	1	1		6	3	3	6	3	1	4	4	3	4	3
digitata	3	.6	1				.5		1									
eggeri	15	10	7	12	7	1	.5		12	5	16	12	10	12	10	8	26	24
inflata					3		5			2	2	1	2	.3	1			
pachyderma										1	6	10	9	8	7	14	7	3
quinqueloba							.5			.5	3	4	2	9		2	7	16
radians	.3									.7	.7	1		.3				
Globigerinella aequilateralis	4	6	6	1	4	5	4											
Globigerinita glutinata		.3	3		14	11	6	14	12	3	3	2	2	2	2	4	1	1
Globigerinoides conglobata											.5							
rubra, etc.	71	65	77	57	43	75	50	78	69	84	56	58	61	57	70	61	44	49
(typical G. rubra present)	×	×	×	×	×	×	×	×	×				×	×				×
sacculifera	2	8		23	27	6	27	1										
tenella	1	5	1					1										
Globorotalia scitula										.5	3	5	7	2	3	8	10	4
truncatulinoides							5		3		3	4	6	4	3			
Hastigerina pelagica		.3					.5											
Orbulina universa	2	3	4	1	1	1	.5							1				
BENTHONIC POPULATION (actual numbers)	12	8	0	13	55	199	135	30	111	106	189	214	113	189	207	268	229	242
Articulina tubulosa & vars.									2		4	1	1	1	4	5	4	
Bolivina albatrossi									5	7	14	9	3	7	32	27	20	11
dilitata dilitatissima						13	79	11	45	13	48	50	31		18	39	58	58
pseudoplicata											1	2		2	1	9	3	1
subaenariensis							7			3	11	20	1	42	1	3		1
Bulimina costata									26	12	16	12	8	12	5	8	6	8
gibba											1	2		3				2
marginata										8	14	11	10	13	8	15	8	17
Cassidulina carinata										6	9	13	6	31	2	11	16	8
crassa															3	6	3	1
cf. oblonga										2	1	5	3	1	3	1	2	3
Chilostomella mediterranensis				13	17	66	22	7	1	2	2	1		4				
Cibicides aff. floridanus										9	8	6	6	11	18	20	30	22
wuellerstorfi										3	1			1			2	4
Elphidium spp.															2			
Gavelinopsis praegeri, etc.														1	1	1	1	
Globobulimina affinis						100		8	20	2	12	21	13	11	4			
pseudospinescens					35		21	1			1							
Glomospira charoides	1	2																
Gyroidina altiformis	3								1	10	3	3	3	1	8	3		
cf. neosoldanii	1	2							1	3				1	4	2	1	1
umbonata													1			1	1	4
Hoglundina elegans									4		6	2	1	3	32	12	7	
Hyalinea balthica										2	3	10	5	[illegible]	1	1	1	[illegible]
Involutina cf. planorbis	2	1																
Loxostomum alatum							5	2	1	2	2	7		6	1		1	1
Miliolidae									1	1	5	3	1		6	10	9	1
Miliolinella circularis		1							1	2	1	2		1		11	2	
Nonion barleeanum, etc											3	3	2	7	1	5		1
Planulina ariminensis											2			2	3	10	2	9
Pullenia quinqueloba										1		1						2
Pyrgo anomala										2		1	1		1	1	1	
murrhina										1		2	1					
Pyrgoella sphaera													1				2	
Quinqueloculina aff. lamarckiana										1			1		1	3		
Robulus spp.												2	1		1			
Sigmoilina tenuis										2	1		2			1		
Sphaeroidina bulloides										1	3	1		2	1	1	6	2
Spirillina vivipara																2		
Uvigerina mediterranea	4									11	6	11	5	4	25	18	6	20
peregrina											6	5	2	8	9	15	33	48
Virgulina mexicana		2			3	16	1	1						3				
Miscellaneous spp.	1					4			2		1	5	4	5	11	13	3	3
spp. listed elsewhere									1		3	1				4	1	

TABLE 6. Distribution of Foraminifera in selected samples from Core 184.

CORE 186

SAMPLE	1	2	4	5	6	7	9	13	18	24	28	32	37	42	46	49	50	51	53	54	59	60	61	65	67	70	72	73	74	75	77	80	81	82	83	85	86	88	90	94	98	106
DISTANCE FROM TOP (CM.)	0.5-1	9.5-10	29.5-30	39.5-40	49.5-50	59.5-60	79.5-80	119.5-120	169.5-170	229.5-230	269.5-270	311-311.5	359.5-360	409.5-410	449.5-450	479.5-480	489.5-490	499.5-500	519.5-520	529.5-530	579.5-580	589.5-590	599.5-600	639.5-640	659.5-660	689.5-690	709.5-710	719.5-720	729.5-730	739.5-740	759.5-760	789.5-790	799.5-800	809.5-810	819.5-820	839.5-840	849.5-850	869.5-870	889.5-890	929.5-930	972-972.5	1050-1050.5
PLANKTONIC POPULATION (%)	1600	580	40	470	830	180	730	1100	3200	1800	2100	3700	2700	1500	650	6700	2600	3200	840	2000	2400	3900	2200	2600	4000	7400	2900	2600	6500	2500	980	380	4400	3300	2800	8900	2500	4700	110	1800	6500	5700
Globigerina bulloides	4	7	9	7	16	18	10	13	8	22	17	19	15	20	10	17	19	15	16	17	15	16	17	15	20	14	17	12	18	10	16	11	21	12	16	17	15	15	5	24	6	16
digitata	1																				.3	.6																				
eggeri	.5				16	5	19	14	10	26	17	22	18	15	9	42	5	14	14	21	8	22	26	34	26	50	20	18	33	23	28	6	43	51	49	53	60	61	51	52	70	57
inflata				.4	7	.6	5	6	1	5	4	9	1	1	20	2	2	6	10	4	8	2	5	4	7	2	9	8	6	7	5	15	3	3	3	2			2				
pachyderma					2		2	2	1	8	4	2	1	3	1	9	2	.5	2	7	1	4	3	2	4	4	1	1	2	2	4	1	1	2	6	3	1	1	1	2	2	1
quinqueloba					7	3	2	2	1	7	5	6	4	5	3	7	5	1	3	6	4	9	10	3	1	9	3	3	3	2	8	2	3	12	6	13	17	21	35	13	16	17
radians						.6																			.4	1	.3															
Globigerinella aequilateralis	5	2		2									.6	.3	.3			.7		.6	.3	.6		2	2	.5					.4			.4							
Globigerinita glutinata	1			10	4	8	4	2	6	1	3	1	2	2	1	2			1	3		2	4	4	2	2	.5	2	2	5	3		2	4	4	2	7.3	1	2	2	9
Globigerinoides conglobata													.3					1							.4	.4					.4				.6							
rubra, etc.	78	90	73	66	44	60	50	50	55	19	38	33	43	35	41	10	66	54	40	28	67	34	24	26	22	10	33	27	22	28	19	39	10	10	11	4		1	4	4		
(typical G. rubra present)	x	x	x	x		x		x		x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x				
sacculifera	8		18	13			1	1		1	.4			.3				.5		.6		2	1	1	1	.6	.3	.3	2	10	4	11	2		.6	.4				.6		
tenella					2	3	3	.6		1	2	1	1	1	5	1		1	3	3	1	2	2	.6	1	1	.3	5	2	1	2	.5	.5	.5	.3	.4						
Globorotalia scitula					2	.6	1	2	7	7	8	5	2	2	2	8	1	2	3	4	4	3	5	3	10	5	4	1	4	3	4	.3	2	1	1	6				.4		
truncatulinoides				1		.6	1	5					.3	.5	.3				6	.4	.3			1	.4	.4	3	20	4	1	1	10		1								
Hastigerina pelagica		.3																									.3														
Orbulina universa	2	.7		.6		.6	2	2	.6	3	3	2	2	4	7	2		4	2	5	.7	2	2	4	2	1	7	2	2	8	5	3	2	3	2	1		.7	1	2	4	
BENTHONIC POPULATION (actual numbers)	4	—	9	—	9	11	62	29	26	20	62	83	67	32	47	45	53	33	15	21	35	25	30	17	10	63	16	28	93	16	4	11	19	5	9	105	—	0	0	6	0	0
Articulina tubulosa & vars.							2	2		1	4	3	7	1	14	6	31	1	1	1			1			5			1	1		2	3	1		12						
Bolivina albatrossi						1		4			1	2	3	2		2	1	3		3	1	3	5			4	2	8	2	2		3				1	4						
catanensis				1									1				2	1				1							10	1				1								
dilitata dilitatissima			1			1					1			1	1								1						22	1					4							
Bulimina costata									2	1	7	4	4	1	2	4	5					1		4		4			1	1			1			4						
exilis								1		2	2	2	3	2		4			1		1	1	2		2	3	1			3	2	1					46	1					
marginata														1															3	1			1		1							
Cassidulina carinata					2	5			5	3	2	7	7	3	11	1	4	3		1	2		1			1			12				1			2						
crassa																	1		2																							
cf. sicula																																				2						
Cassidulinoides tenuis																																				3						
Chilostomella mediterranensis			5						1											1							1	1								1						
Cibicides aff. floridanus		1	1		2		38	4	16	2	21	23	15	5	10	1		1			2	1	2	1		2	4	1	5	1			3		1	2						
kullenbergi												1	3			3																							1		
wuellerstorfi									1		1	2	2	1			1																								
Eggerella bradyi, etc.							1	1			1	1										3		2	1	2		2	9	3			1			3				1		
Epistominella rugosa convexa												1		1				3	1					1									1								
Gavelinopsis praegeri, etc.								2				1		1		1							1																		
Globobulimina affinis	1				1	1	2	2		1	3	3	5	4		3			1	5				3	1		5	9	5	1		5	3	1	1	1						
Gyroidina altiformis											1	1						3		1		1																			
delicata																																				2			3			
cf. neosoldanii	2				1			3			1	3	2					1	4		6	2	3	2		4	1	3		1	3		1			3						
Hanzawaia rhodiensis																													2												
Höglundina elegans								1		2		3	2		1	1					5	5	7	1			1	1														
Hyalinea balthica																1			1	2																					
Miliolidae					1	1	9	2	1	2		5	2	2	2	4		2		1		1	1	1	2	1		2		1			1			3						
Miliolinella circularis							4	1				7	4	5	2	3	5	8	1	1	14			1		1	1			2						1						
Pseudoeponides umbonatus var.																1													1							1			1		
Pullenia quinqueloba												1	1	1	2	1				1																					
Pyrgo anomala							2	1				1				2					1				2																
lucernula							2	2			3					1		3								1	3		2												
murrhina										2	3	1														1															
Quinqueloculina aff lamarckiana												3																	1												
Robertina translucens																2		1			1	1			1				2						1						
Robulus spp.												1										1				1															
Spiroloculina canaliculata													1				1	1				1																			
Uvigerina peregrina					1					2	5	2	2	1	1		2		1										2												
Virgulina mexicana			1																							1									1						
Miscellaneous spp.						2	2	1		1	5	4	3	1	1	3		2	2	2	3	1	7	2	1	4			3			3	2	1	1						
spp listed elsewhere	1		1		1			2		1		1			1							1					1	3		1										

TABLE 7. Distribution of Foraminifera in selected samples from Core 186.

CORE 187

SAMPLE	1	2	7	10	16	18	19	21	22	23	24	29	31	33	34	35	37	38
DISTANCE FROM TOP (CM)	3-3.5	9.5-10	59.5-60	87.5-88	149.5-150	169.5-170	179.5-180	199.5-200	209.5-210	219.5-220	229.5-230	279.5-280	299.5-300	319.5-320	329.5-330	339-339.5	359.5-360	369.5-370
PLANKTONIC POPULATION (%)	2900	5000	7100	1600	7500	1500	9300	2800	4900	6000	2000	4200	1600	5100	2700	1100	5900	2000
Globigerina bulloides	9	13	11	7	15	14	17	11	16	7	17	12	5	11	7	12	10	6
digitata								.3	1		1				.3			4
eggeri	16	20	19	11	18	12	15	24	19	13	7	24	6	23	33	19	13	17
inflata	1					1	21	6	.9	5	23	12	16	6	2		7	5
pachyderma	11	11	12	15	18	8	5	2	3	3	2	3	1	3	3	2	1	
quinqueloba	11	12	9	2	13	9	10	7	.1	29	6	10	2	2	.6		1	.6
radians		.3			1	.3												
Globigerinella aequilateralis	.3						.5		.5				2	3	2	.7		2
Globigerinita glutinata	5	9	9	7	7	9	3	.4	4	14	10	1			.3		.3	.4
Globigerinoides conglobata													7					
rubra, etc	35	22	25	48	17	29	20	46	17	11	12	33	56	41	27	49	62	57
(typical G. rubra present)							x							x	x			
sacculifera	.3						.3		.5				2					
tenella			.4	.5		3			.5	3	2		.5	2	7			3
Globorotalia scitula	10	12	14	9	11	10	7	2	6	15	13	4	1	1	7	6	5	1
truncatulinoides	1								.5					1				
Hastigerina pelagica																		
Orbulina universa	.3					4	1	.3	2		7	1	1	7	10	11		4
BENTHONIC POPULATION (actual numbers)	16	24	60	16	33	13	43	45	49	22	14	63	7	8	0	0	11	7
Articulina tubulosa & vars		1	5		6	3	6	29	17	4	3	19	4				5	3
Bolivina dilitata dilitatissima	1																	
Bulimina costata		1								1		1						
exilis																		
gibba							4							1				
marginata									1			1						
Cassidulina carinata	1	3	4	2	3	1	1					6						
cf. sicula								8	9	4	2	7						
Chilostomella mediterranensis																		
Cibicides aff. floridanus	1		6	1	2		3		1	2								
kullenbergi																		
Eggerella bradyi, etc									1									
Globobulimina affinis												1		3				
? sp																		
Gyroidina delicata																		
cf. neosoldanii			1											2				
Höglundina elegans																		2
Loxostomum alatum																		
Miliolidae	4	4		8	2	4	3	1	6		1	7					2	
Miliolinella circularis	2	3	3	1	1		4	4	7	5	1	19	2				2	
Pseudoeponides umbonatus var																		
Pullenia quinqueloba						1	1											
Pyrgo anomala																		
lucernula	1		2		1		6	1	1	1	2			2				
murrhina		4	10	2	4		2		1									
Quinqueloculina aff lamarckiana	+	4	22		12	1	9		1	4								
Robertina translucens			1			1	1											
Robulus spp																		
Spiroloculina canaliculata			1								1							1
Spirophthalmidium acutimargo		2			1							1						
Miscellaneous spp	2	2	4	2	1	1	3	2	4		4	1	1				2	
spp listed elsewhere			1			1				1								1

SAMPLE	42	46	47	48	50	51	52	53	55	57	62	65	69	70	71	73	74	75
DISTANCE FROM TOP (CM)	409.5-410	439.5-440	449.5-450	459.5-460	469.5-470.5	479.5-480	489.5-490	499.5-500	519.5-520	538-538.5	577.5-578	607.5-608	645-645.5	649.5-650	659.5-660	679.5-680	689.5-690	701-701.5
PLANKTONIC POPULATION (%)	8000	520	560	6500	120	550	2200	2600	2400	1400	1900	5700	2200	930	5400	1400	1000	31000
Globigerina bulloides	14	16	9	19	10	8	7	6	12	7	6	23	12	26	36	10	11	25
digitata		1					2	1	3	2	2							
eggeri	23	32	31	25	3	10	7	5	5	11	19	11	1	11	16	28	7	47
inflata	4	.4		13	8	.4	4	5	.3		.4		12	7	9		5	
pachyderma	5	1	2	8	1	.7	2	.3	.7		1		3	27	11	21	2	2
quinqueloba	2	10	4	3		21		.6	.3	2	1		2	1	3	13	23	22
radians		1		.5		4				.3	.4	1			3			
Globigerinella aequilateralis	3	2	3		2	.7	2	1	.3	2	1	3	1					.4
Globigerinita glutinata		2	.4	3	1	20	2	1		1		7	3	1	10	5	9	
Globigerinoides conglobata							.4	2					2	12				
rubra, etc	42	18	27	16	40	13	65	69	68	69	59	37	38	10	4	.6	23	
(typical G. rubra present)	x	x	x	x		x	x	x	x	x	x	x						
sacculifera	1						1	1	5		6	5	5					
tenella	1	7	2	2		3	1			2	2	3	10	.4		.3	1	
Globorotalia scitula	1	8	7	8	2	17	1	1		3		4	8	4	7	13	14	.6
truncatulinoides		.4	.4		19	.7												
Hastigerina pelagica		.4				.4												
Orbulina universa	3	.4	14	2	14	1	5	7	5	.3	2	6	3		.3	9	4	3
BENTHONIC POPULATION (actual numbers)	12	16	9	91	0	33	2	3	2	3	2	0	17	3	8	3	21	11
Articulina tubulosa & vars			1	77		1	1			1			1	1	2		1	1
Bolivina dilitata dilitatissima		2	2			1												
Bulimina costata	1					1							1		1		10	
exilis			1															2
gibba	2	1																
marginata		6				1											1	
Cassidulina carinata																		
cf. sicula						5										1		
Chilostomella mediterranensis		2				2												
Cibicides aff. floridanus																		
kullenbergi	1																	
Eggerella bradyi, etc																		
Globobulimina affinis				4														
? sp																		5
Gyroidina delicata															1			1
cf. neosoldanii	3		1							2								
Höglundina elegans																		
Loxostomum alatum						2												
Miliolidae	2					2	1	2	1				4	1	1	2	1	
Miliolinella circularis						2			1									
Pseudoeponides umbonatus var	1												5					2
Pullenia quinqueloba																		
Pyrgo anomala		1											3				3	
lucernula																		
murrhina																		
Quinqueloculina aff lamarckiana																		
Robertina translucens																		
Robulus spp	1			1													1	
Spiroloculina canaliculata																		
Spirophthalmidium acutimargo																		
Miscellaneous spp		3	1	8		11		1			2		2	1	3		4	
spp listed elsewhere	1	1	3	1		5							1					

SAMPLE	77	79	82	83	84	85	86	88	94	95	96	97	99	100	101	102	103
DISTANCE FROM TOP (CM)	719.5-720	739.5-740	765.5-766	771-771.5	779.5-780	787.5-788	800.5-801	813-814	858.5-859	869.5-870	879.5-880	889.5-890	909.5-910	919.5-920	929.5-930	939.5-940	949.5-950
PLANKTONIC POPULATION (%)	530	4200	3800	780	1600	4000	57000	87000	28000	4200	4400	11000	6200	6700	5100	3800	1100
Globigerina bulloides	20	5	7	4	6	20	9	13	35	18	7	12	26	2	8	11	22
digitata	.4								.5	2	2			.5	.6		3
eggeri	6	35	2	22	6	33	64	63	18	8	7	22	3	1	3	2	1
inflata	9	6	24	20	18	14			3	14	7	6	.3	7	13	6	14
pachyderma	.4			10	1	5	6	4	27	2				2	2	1	4
quinqueloba		.4	.4	.3	.5	7	15	16	2	1			.3		1	1	
radians			.4														.5
Globigerinella aequilateralis		.4	5		1					1	1	3	1	2	1		.5
Globigerinita glutinata		1	3	2		3	3	3		1	2	3	11	2	5	1	7
Globigerinoides conglobata																	
rubra, etc	52	22	39	31	38	12	1		5	33	59	41	50	61	62	73	36
(typical G. rubra present)		x	x	x	x					x	x	x	x	x	x	x	
sacculifera		8	8	6	4									1	.6		
tenella		.4							.7			1	3	2	.3		2
Globorotalia scitula	2		2	.3	1	4			4	5		3	.3		1	2	10
truncatulinoides	8	9		.3	23					15	8	.6	4	13	.6	2	
Hastigerina pelagica																	
Orbulina universa	2	12	9	4	1	2	2	1	4		7	8	1	6	1	.4	
BENTHONIC POPULATION (actual numbers)	2	0	3	0	7	8	0	0	29	11	10	9	0	4	5	0	10
Articulina tubulosa & vars			3			2			6	1	4	7		1	1		5
Bolivina dilitata dilitatissima																	
Bulimina costata																	
exilis																	
gibba																	
marginata																	
Cassidulina carinata																	
cf. sicula															2		1
Chilostomella mediterranensis						1			1			1					
Cibicides aff. floridanus																	
kullenbergi	1								12	8							
Eggerella bradyi, etc						1					2			1	2		
Globobulimina affinis					3				2								
? sp																	
Gyroidina delicata						1											
cf. neosoldanii					2				1			1		1			
Höglundina elegans																	
Loxostomum alatum																	
Miliolidae									2								
Miliolinella circularis																	1
Pseudoeponides umbonatus var																	
Pullenia quinqueloba									1								
Pyrgo anomala																	
lucernula																	2
murrhina						1											
Quinqueloculina aff lamarckiana																	
Robertina translucens									2	1	1			1			
Robulus spp																	
Spiroloculina canaliculata																	
Spirophthalmidium acutimargo											1						
Miscellaneous spp	1				2	2			2	1	1						1
spp listed elsewhere											1						

TABLE 8. Distribution of Foraminifera in selected samples from Core 187.

CORE 188

SAMPLE	1	2	6	7	8	9	10	15	18	19	20	22	25	26
DISTANCE FROM TOP (CM)	2 - 2.5	9.5 - 10	49.5 - 50	59.5 - 60	69.5 - 70	79.5 - 80	89.5 - 90	139.5 - 140	169.5 - 170	179.5 - 180	191 - 191.5	209.5 - 210	239.5 - 240	252 - 252.5
PLANKTONIC POPULATION	2600	1000	390	1400	4700	3500	6400	7400	480	1600	5600	2100	170	3700
(%)														
Globigerina bulloides	3	5	6	7	4	14	6	13	1	10	4	20	23	13
digitata	2	.4							3	1		.4		2
eggeri	6	2	6	6	2	13	13	16	1	9	9	15	14	12
inflata	10	4	5	15	27	6			51	13	4	11	13	26
Virgulina mexicana														
Miscellaneous spp.				1		2	5	2		1	2			
spp. listed elsewhere	1					1				1	1			

SAMPLE	29	36	37	39	40	41	42	44	45	51	52	54	58	63
DISTANCE FROM TOP (CM)	279.5 - 280	349.5 - 350	359.5 - 360	379.5 - 380	392 - 392.5	399.5 - 400	409.5 - 410	429 - 429.5	438.5 - 439	499.5 - 500	511 - 511.5	528.5 - 529	559.5 - 560	609.5 - 610
PLANKTONIC POPULATION	3400	14000	3200	4700	1600	4000	9700	500	3100	290	4300	5400	510	2000
(%)														
Globigerina bulloides	15	29	17	8	3	13	18	8	32	7	13	11	5	10
digitata				1	.3	5	.3	.4						
eggeri	2	29	27	13		13	29	24	24	9	25	17	2	21
inflata	30	11	10	12		7	8	1		5	1	1	3	16
Virgulina mexicana														
Miscellaneous spp.	1	1		5						1				
spp. listed elsewhere														

SAMPLE	65	66	67	68	69	70	73	78	79	83	84	86	90
DISTANCE FROM TOP (CM)	629 - 629.5	639.5 - 640	649.5 - 650	659.5 - 660	669.5 - 670	679.5 - 680	709.5 - 710	759.5 - 760	769.5 - 770	808.5 - 809	819.5 - 820	839.5 - 840	879.5 - 880
PLANKTONIC POPULATION	3900	1900	1800	860	8800	600	47000	220	400	6500	20000	11000	13000
(%)													
Globigerina bulloides	7	7	6	5	16	39	15	14	4	29	27	30	29
digitata	6	1					2						
eggeri	12	16	13	23	19	4	22	28	3	15	15	18	14
inflata	5		1	26	17		1	.5			2	5	3
Virgulina mexicana							4						
Miscellaneous spp.			1				57				3	1	1
spp. listed elsewhere							10	1					

TABLE 9. Distribution of Foraminifera in selected samples from Core 188.

CORE 189

SAMPLE	1	2	7	11	12	13	14	16	17	18	19	20	21	22	23	25	26	27	28	29	30
DISTANCE FROM TOP (CM)	25-3	9.5-10	595-60	99.5-100	109.5-110	119.5-120	129.5-130	149.5-150	159.5-160	169.5-170	179.5-180	189.5-190	199.5-200	209.5-210	218-218.5	224-224.5	2285-229	239.5-240	249.5-250	259.5-260	268.5-269
PLANKTONIC POPULATION	2300	7400	7200	4900	5300	4700	1400	2300	4300	3100	8400	8400	3300	6700	13000	10000	8800	6000	3300	2400	5800
(%)																					
Globigerina bulloides	10	12	29	23	15	23	7	10	10	43	23	8	11	15	12	19	14	6	15	19	9
digitata	2		.4				4	4	2		4			2	.5	1			9	.7	.3
eggeri	5	12	11	5	9	6	4	2	12	6	20	2	7	7	27	22	26	6	5	9	20
inflata	1			9	8	7	29	14	16	13	9	5	11	10	4	.3		4	12	3	10
pachyderma	1	18	17	2	3	2	1		9	1	6		.5	2	3	.3	2		2		4
quinqueloba	2	2	6	18	14	16	4	4	5	25	16	4	2	2				1	1	4	1
radians			.6																		
Globigerinella aequilateralis	3							1					3	3	3	2	1	1	2	8	7
Globigerinita glutinata	4	8	5	15	15	11	6	2	2	2	1				2		.4	.5		.7	5
Globigerinoides conglobata																					
rubra, etc	57	33	14		19	20	18	44	33	4	14	80	50	44	22	18	45	78	46	43	26
(typical G rubra present)	x														x	x	x				x
sacculifera	10																				
tenella	2	.4			2	.3	4	5	4	.3			1	3	7	22	2		3	3	4
Globorotalia scitula	1	14	17	28	15	14	5	1	3	5	4	1	7	2	10	2	5	3	1	.3	7
truncatulinoides														5	.5					1	
Hastigerina pelagica							.3						1					.3	1	1	
Orbulina universa	2						17	13	4		3		6	5	9	13	4		3	7	6
BENTHONIC POPULATION (actual numbers)	2	30	41	11	14	27	16	10	54	136	121	95	21	61	49	0	0	2	9	2	24
Articulina tubulosa & vars.		10	13	7	8	5	5	3	17	77	72	52	6	54	26			1	8		22
Bulimina aculeata																					
costata																					
exilis																					
Cassidulina carinata		1		1						4											
cf. sicula		1			1	3	3	2	5	7	12	1									
Cassidulinoides tenuis																					
Chilostomella mediterranensis														1	7						
Cibicides aff floridanus					1					2											
kullenbergi																					
Eggerella bradyi, etc.																					
Epistominella rugosa convexa														1							
Gavelinopsis praegeri, etc.																					
Globobulimina affinis															14						2
? sp.																					
Glomospira charoides												2		1							
Gyroidina delicata																					
cf. neosoldanii														3				1		2	
Miliolidae		2	1	1	2	1			1	1	2	2	1								
Miliolinella circularis		3	5	1	1	6	8	5	23	36	34	33	14								
Pseudoeponides umbonatus var.																					
Pullenia bulloides																					
quinqueloba																					
cf. riveroi																					
Pyrgo anomala																					
lucernula	1																				
murrhina	1	7	7																		
serrata																					
Pyrgoella sphaera																					
Quinqueloculina aff lamarckiana		4	9		1	11															
Robertina translucens		1							4	2											
Robulus spp.										2											
Spiroloculina canaliculata									1	1		1									
Spirophthalmidium acutimargo			2							1	1										
Virgulina complanata																					
mexicana																					
Miscellaneous spp		1	4	1		1			3	3		4		1	2				1		
spp listed elsewhere																					

SAMPLE	31	33	34	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
DISTANCE FROM TOP (CM)	281.5-282	289.5-290	299-299.5	319.5-320	329.5-330	339.5-340	350.5-351	359.5-360	369.5-370	379.5-380	388.5-389	399.5-400	409.5-410	419.5-420	429.5-430	439.5-440	449.5-450	459.5-460	469.5-470
PLANKTONIC POPULATION	23000	4800	3400	2900	24000	3900	5300	7800	9400	11000	4600	6700	5400	1800	23000	42000	29000	5700	12000
(%)																			
Globigerina bulloides	15	14	15	11	7	38	9	27	20	26	26	16	14	9	5	25	20	15	8
digitata			4	1	1					.6		.5		2				.3	
eggeri	66	4	2		11	20	3	16	19	19	18	21	33	13	66	28	38	3	59
inflata	3	19					12	2	3	6				4	1		2	10	7
pachyderma	.3	.3					5	15	13	22	14	15	15	2	4	1	14	.6	1
quinqueloba	7	.7		.3	2	1	.6	6	3	7	17	11	9	14	15	41	7	1	2
radians	.3				2		.3		1										
Globigerinella aequilateralis		4	4	3	3	.6	4											2	.3
Globigerinita glutinata	.6		.5	.3	12	2	11	3	5	5	16	8	4	5	1		5		.3
Globigerinoides conglobata		4	3	1			1	5											
rubra, etc		34	60	60	40	29	32	8	20	2			10	35	1		2	44	13
(typical G rubra present)			x	x	x	x	x												x
sacculifera			.7	6	1		12												1
tenella	.4	5	4	14	16	8	5	7		3	1		.4	.5	.3			14	4
Globorotalia scitula	5	2			.3	1	.3	11	16	5	8	12	4	7	6	2	8	.3	1
truncatulinoides														1				5	1
Hastigerina pelagica			.7	1														.3	
Orbulina universa	2	13	6	2	4		4			4		16	10	7		3	4	4	2
BENTHONIC POPULATION (actual numbers)	0	1	1	4	4	0	5	49	4	18	18	7	20	58	257	0	163	5	25
Articulina tubulosa & vars.			1	2	1				1	10	10	3	5	44	1		18	3	1
Bulimina aculeata																			
costata										1	1		2	4					
exilis														2	50				
Cassidulina carinata											1								
cf. sicula																			
Cassidulinoides tenuis															60				
Chilostomella mediterranensis							1								3				
Cibicides aff floridanus																	1		
kullenbergi																	17		
Eggerella bradyi, etc.																	40		4
Epistominella rugosa convexa																			
Gavelinopsis praegeri, etc.																	3		
Globobulimina affinis																			20
? sp.															86				
Glomospira charoides																			
Gyroidina delicata							1	6							40		64		
cf. neosoldanii		1		1	2												1		
Miliolidae								12	2	5	3	1	4	3				1	
Miliolinella circularis								4					1						
Pseudoeponides umbonatus var.							3	12							16		12	1	
Pullenia bulloides																			
quinqueloba										1					1				
cf. riveroi																			
Pyrgo anomala								1				1	2						
lucernula													2	1			1		
murrhina																			
serrata																			
Pyrgoella sphaera								1		1		2		1					
Quinqueloculina aff lamarckiana								4											
Robertina translucens								1									1		
Robulus spp.											1								
Spiroloculina canaliculata																			
Spirophthalmidium acutimargo								2	1										
Virgulina complanata								1											
mexicana																			
Miscellaneous spp				1	1			5			2		3	3			5		
spp listed elsewhere													1						

SAMPLE	52	53	55	56	57	58	59	60	61	62	63	65	66	67	68	69	70	71	72
DISTANCE FROM TOP (CM)	479.5-480	489.5-490	509.5-510	519.5-520	527.5-528	532.5-533	539.5-540	549.5-550	559-559.5	569.5-570	579.5-580	599.5-600	607.5-608	617-617.5	622-622.5	629.5-630	639.5-640	649.5-650	659.5-660
PLANKTONIC POPULATION	6100	4000	21000	46000	46000	22000	5300	27000	9500	6100	3200	6800	2800	6600	3900	6000	3900	14000	1900
(%)																			
Globigerina bulloides	20	31	12	16	3	19	12	10	17	18	32	25	13	11	13	27	16	19	2
digitata		2				1	5		.3		3	1	.3	5	1	1		1	
eggeri	12		26	52	67	24	3	18	1	5	.5	16	1	15	2	4	.4	16	.4
inflata		1	11	1		7	11	4	.3	10	12	11	13	14	15	19	16	16	10
pachyderma		2	2	3	2	16	.4			3	1	18	1	5	1	2	.4	9	
quinqueloba	5	1	4	22	26	6	.6	2	2	5	4	5	1	2	1		1	3	.6
radians										.3	.5								
Globigerinella aequilateralis	4		1				1	6	4	.3				6	3	2	2	2	10
Globigerinita glutinata	11	1	3	1		5	1	6	12	5	5	1			2	4	1	1	.4
Globigerinoides conglobata																			
rubra, etc	20	37	26	1		9	40	38	55	22	27	2	60	25	26	21	48	18	59
(typical G rubra present)	x		x	x				x	x					x	x			x	x
sacculifera		2	5																
tenella	3	6	1			5	2	7	5	13	.5		3	10	21	8	7	6	4
Globorotalia scitula		13	1	.3	2	4	.3	1	.3	5	3	14	4	2	9	8	6	3	
truncatulinoides	5		5			.6	18	.6	3	11			1					2	12
Hastigerina pelagica						.3	.3												
Orbulina universa	20	4	3	3		3	5	7		2	11	7	2	5	6	4	2	4	1
BENTHONIC POPULATION (actual numbers)	0	24	9	10	0	174	11	50	5	38	7	31	12	8	19	102	8	15	2
Articulina tubulosa & vars.		15	4	1		161	7	25		19	3	17	11		9	79	7	12	
Bulimina aculeata																			
costata																			
exilis																			
Cassidulina carinata																			
cf. sicula																			
Cassidulinoides tenuis																			
Chilostomella mediterranensis			1	5				9						4	1				
Cibicides aff floridanus																			
kullenbergi						3									4	16			
Eggerella bradyi, etc.		2													1				
Epistominella rugosa convexa		1																	
Gavelinopsis praegeri, etc.																			
Globobulimina affinis															1				
? sp.																			
Glomospira charoides																			
Gyroidina delicata			1																
cf. neosoldanii						1		1							1		1	1	2
Miliolidae		2								10	1	1							
Miliolinella circularis									1										
Pseudoeponides umbonatus var.				1															
Pullenia bulloides																			
quinqueloba			1	2				1								1			
cf. riveroi						1						1				1			
Pyrgo anomala																			
lucernula		2							2		1		1		1				
murrhina				1								9							
serrata																			
Pyrgoella sphaera																			
Quinqueloculina aff lamarckiana																			
Robertina translucens		1				3	2			4									
Robulus spp.																			
Spiroloculina canaliculata																			
Spirophthalmidium acutimargo																			
Virgulina complanata														2		1		1	
mexicana						3		14						2	1	2			
Miscellaneous spp		1	2			2	2		2	5	1	3				2		1	
spp listed elsewhere											1								

SAMPLE	73	74	75	76	77	78	80	81	83	84	85	86	88	89	90	91
DISTANCE FROM TOP (CM)	669.5-670	678-678.5	683.5-684	689.5-690	699.5-700	709.5-710	729.5-730	739.5-740	759.5-760	769.5-770	779.5-780	789.5-790	809.5-810	818-818.5	829.5-830	839.5-840
PLANKTONIC POPULATION	4100	14000	13000	6200	28000	2700	5000	4500	11000	6000	24000	11000	2200	7800	9600	4400
(%)																
Globigerina bulloides	4	12	16	12	34	14	10	15	9	14	25	18	14	17	25	22
digitata		1	.5	.5				1	.3	2	1	.3	1	.4	.3	1
eggeri		5	1	10	20	4	4	1	12	3	25	37	13	13	4	9
inflata	17	23	2	16	7	9	8	4	11	10		1	1	14	10	4
pachyderma				3	11	3	1		.6	1	16	17	5	2	2	4
quinqueloba			1	1	6	19	1	1	.6	1	18	6	1	.4	1	5
radians		.5	1	.5						.3						
Globigerinella aequilateralis	2	7	3	3	2		3	2	2	5			2	1	2	3
Globigerinita glutinata	.4		12	3	4	2	4	1	2	11	11	4	1	2	3	7
Globigerinoides conglobata									.6				3			
rubra, etc	64	36	43	41	6	41	29	55	27	32	1	4	46	26	30	31
(typical G rubra present)		x	x	x	x	x			x	x				x	x	x
sacculifera	3								9	.3			.4	3	10	1
tenella	6	5	14	3	4	3	7	2	5	13	.3	5	1	4	3	7
Globorotalia scitula				1			5	.4	5	3		7	3	2	5	2
truncatulinoides		8	.3			4	23	12	11				3	9		1
Hastigerina pelagica	.4	.5											.4			
Orbulina universa	3	2	6	6	6	1	5	5	4	4	2	.3	3	6	4	3
BENTHONIC POPULATION (actual numbers)	4	9	0	31	1349	32	5	16	6	0	1020	106	24	8	28	26
Articulina tubulosa & vars.	4	8		1	26	1	2	6			2	15	4	5	6	1
Bulimina aculeata		1		25	1280				5		896					
costata				1		1										
exilis																
Cassidulina carinata																
cf. sicula											1					
Cassidulinoides tenuis																
Chilostomella mediterranensis									1			1				3
Cibicides aff floridanus																
kullenbergi													2			1
Eggerella bradyi, etc.						1										
Epistominella rugosa convexa																10
Gavelinopsis praegeri, etc.																
Globobulimina affinis												1			1	5
? sp.																
Glomospira charoides																
Gyroidina delicata					3						7					
cf. neosoldanii				1				1			1	2	1	1	4	1
Miliolidae					19	3										
Miliolinella circularis					2	17										
Pseudoeponides umbonatus var.				3				7			1	12	15	2	12	
Pullenia bulloides															2	3
quinqueloba																
cf. riveroi																
Pyrgo anomala					4		1									
lucernula																
murrhina					12	5					11	32				
serrata											80	38				
Pyrgoella sphaera																
Quinqueloculina aff lamarckiana																
Robertina translucens																
Robulus spp.																
Spiroloculina canaliculata																
Spirophthalmidium acutimargo					1	1						1				
Virgulina complanata					1			2			11	1				
mexicana																
Miscellaneous spp					1	3	2				10	2	2		3	2
spp listed elsewhere												1				

TABLE 10. Distribution of Foraminifera in selected samples from Core 189.

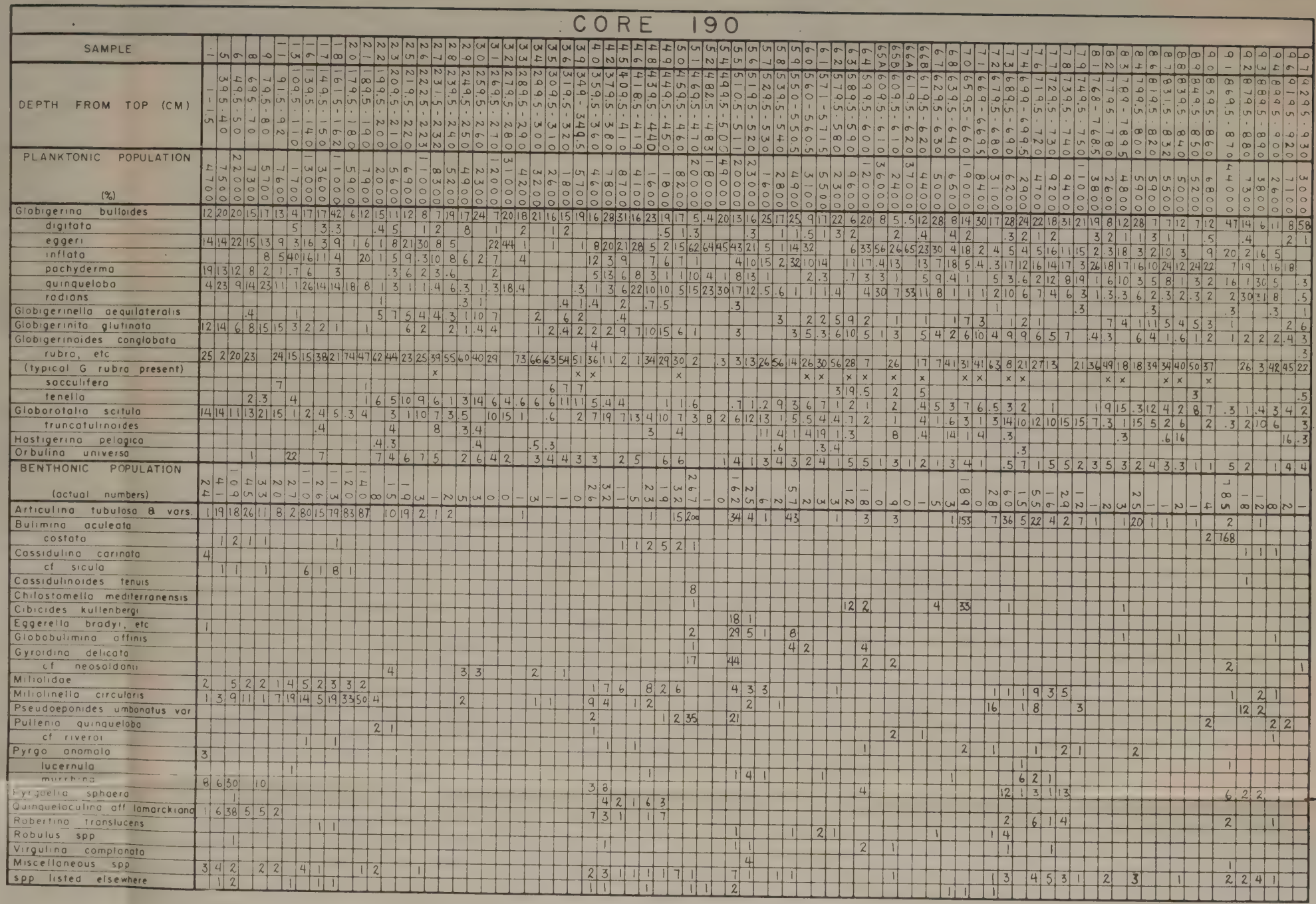


TABLE 11. Distribution of Foraminifera in selected samples from Core 190.

CORE 191

SAMPLE	1	2	3	4	5	7	10	11	13	14	15	17	18	19	20	22	23	26	27	28	29	30	32	33	34	36	39	40	41	43	44
DISTANCE FROM TOP (CM.)	3-3.5	9.5-10	18.5-19	25.5-26	31-31.5	45.5-46	68.5-69	76.5-77	96.5-97	106.5-107	116.5-117	139.5-140	145.5-146	154.5-155	163.5-164	184.5-185	194.5-195	219.5-220	229.5-230	240-240.5	246.5-247	255.5-256	274.5-275	279.5-280	289.5-290	309.5-310	339.5-340	347-347.5	350.5-351	361.5-362	367-367.5
PLANKTONIC POPULATION (%)	2100	3500	5500	2800	3300	6800	8000	19000	2100	1600	6400	1300	2000	3500	2500	3300	5000	3800	5800	1400	5200	3100	3000	2700	5100	1800	19000	21000	8800	5000	3500
Globigerina bulloides	10	15	28	18	19	28	15	21	22	15	8	6	9	23	11	13	7	22	24	11	17	18	20	12	8	13	41	33	8	4	2
digitata		1								2	.5	3			3	1	.3			1	.6	1	.5	1		4			1		
eggeri	9	21	21	20	20	22	26	23	7	8	30	14	63	5	19	12	16	11	3	2	10	2	.3	4	15	2		1	8	38	40
inflata	21	8	3	2	3	11	1	1	16	6	8	1	1	15	10	24	17	12	.6	20	14	16	19	10	19	5	4	3	15	26	24
pachyderma	2	6	19	20	21	18	20	33	.4	.5	.5			2	1	.7	6	32	34	2	5	3	2	4	14			4	8	10	
quinqueloba	6	1	5	4	4	6	18	7	7	8	2	5	25	7	7	10	6	4	10	4	5	3	5	3	3	8	7	1	1	6	6
radians			.3	1	.5	1	.4		1	1		.6		.5						.3				1		1	2	1			
Globigerinella aequilateralis		2			.5					.5	1	5			1		.3			1		4		4	2	2	3	1	3		
Globigerinita glutinata	4	2	1	4	6	8	6	4	1	.5	.3	6	.4	4	9	5	6	1	1	2	6	10	12	8	2	2	7	11	3	2	3
Globigerinoides conglobata		2	3																				.5								
rubra, etc.	34	27	6	15	13	.5		.5	25	38	27	46		28	25	23	32		16	36	21	31	16	35	18	57	22	35	43	2	
(typical G. rubra present)											×	×												×			×	×	×		
sacculifera		.4									5	5																			
tenella	2	5	3	1		1	1		1	1	3	2		.7			1			9	1	3	1	5	7	3	5	8	6		
Globorotalia scitula	3	3	9	15	12	3	10	6	13	3	3	1	.4	6	4	11	4	10	8	7	16	5	16	7	10	3			1	13	14
truncatulinoides		.4					.4		4	1	7	.3		6																	
Hastigerina pelagica											.3									.3											
Orbulina universa	8	5	.6		1	1	2	4	2	15	4	4	1	2	10		4	8	3	4	4	4	7	6	2		9	6	7	.3	.5
BENTHONIC POPULATION (actual numbers)	16	23	37	7	6	11	20	22	58	3	15	2	48	34	31	8	32	10	16	59	17	9	62	51	38	0	1	8	11	11	14
Angulogerina angulosa							1														1			1							
Articulina tubulosa & vars.	12	1	17	3	1	3	6	16	17	32	1	8		38	28	22	6	4	9	10	46	11	3	9	16	14					1
Bolivina difformis										1						1					1										
dilitata dilitatissima						1																		1	1						
pseudoplicata						2	2		2	5		1		3			1			4	2	1	1	7	3	1			1		1
Bulimina aculeata																														7	9
marginata										1														1	1				1		
Cassidulina carinata									1	1														1	2						1
crassa										1	1													3	1	2					
cf. oblonga												1					1					1		2							
subglobosa																								4							
Elphidium spp.										1				1										1		1					
Gavelinopsis praegeri, etc.																								3	1	2					
Gyroidina delicata								2																	1						
Miliolidae			1		3											4					1			4		2					
Miliolinella circularis	3																														
Neoconorbina williamsoni									1	4		3			1						1			2	1	4					
Nonion barleeanum, etc.																								3	1						
sp. B																1								1		1					
Planorbulina mediterranensis																								2	2						
Pseudoeponides umbonatus var																															
Pullenia cf. riveroi																		1				1	1								
Pyrgo anomala																		3													
murrhina		1	1											1				22													
Robertina translucens									3					2	1																
Rosalina aff. columbiensis									1						1									2	1	1					
obtusa									1													1				2					
spp											1													2							
Virgulina complanata														1										2	1			1			
Miscellaneous spp.	1		2		2			1	1	3	1	2		1	3	3			1	1	6	1	3	9	13	4			1	2	2
spp. listed elsewhere		1	2		1		2	1		4			1	1			2		1	1	1	1	5	3	3		1	1			

TABLE 12. Distribution of Foraminifera in selected samples from Core 191.

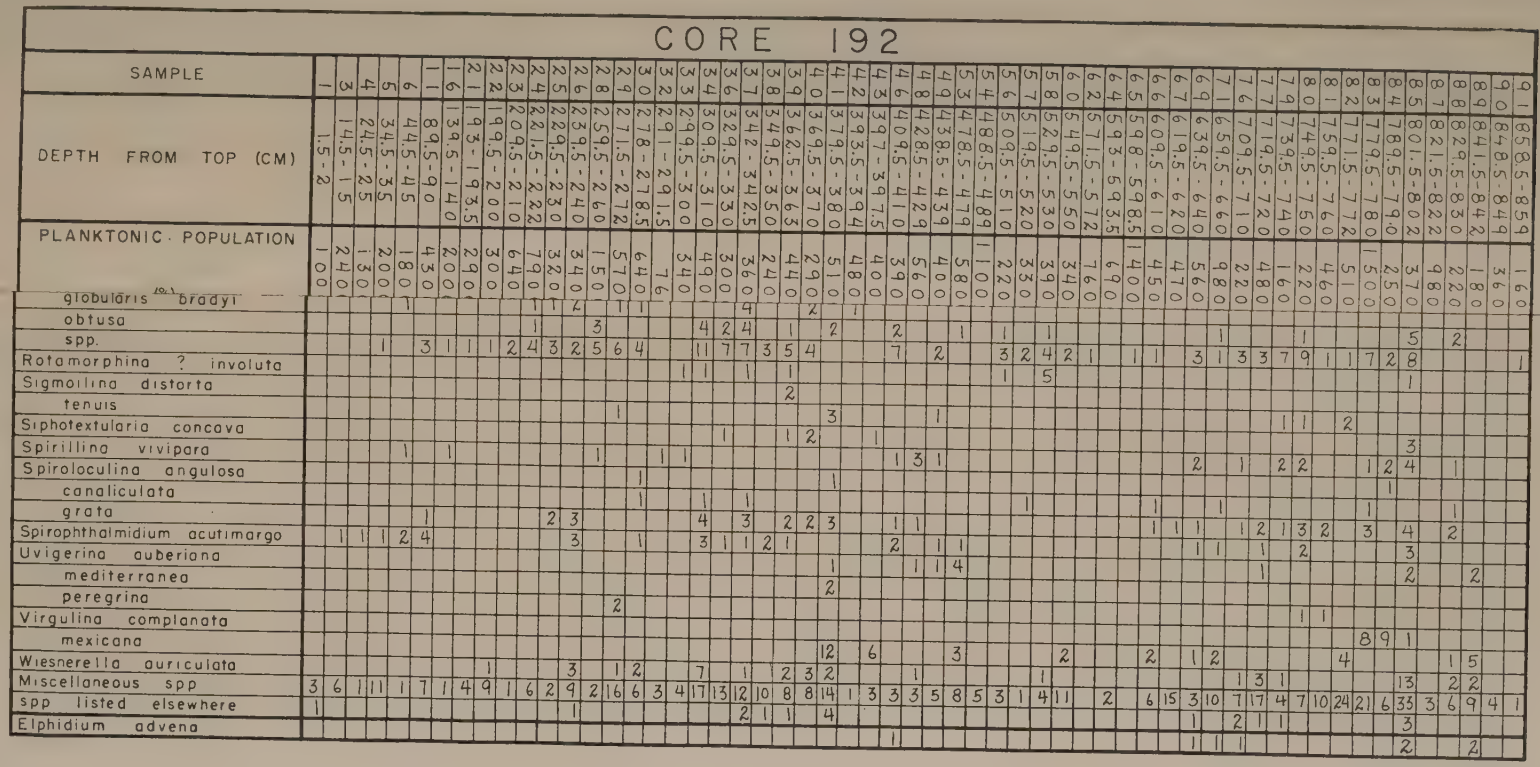


TABLE 13. Distribution of Foraminifera in selected samples from Core 192.

CORE 193

SAMPLE	DEPTH FROM TOP (CM)
64	621.5 -
63	611.5 -
62	599.5 -
60	579.5 -
59	569.5 -
58	559.5 -
57	549.5 -
56	541.5 -
55	529.5 -
54	519.5 -
51	489.5 -
49	469.5 -
48	459.5 -
47	449.5 -
46	439.5 -
45	429.5 -
44	419.5 -
43	409.5 -
42	399.5 -
41	389.5 -
40	379.5 -
39	369.5 -
37	349.5 -
36	339.5 -
35	329.5 -
34	319.5 -
33	309.5 -
32	301.5 -
30	279.5 -
29	269.5 -
28	259.5 -
26	239.5 -
25	229.5 -
24	221.5 -
23	209.5 -
22	199.5 -
21	189.5 -
20	179.5 -
18	159.5 -
17	149.5 -
15	129.5 -
14	119.5 -
11	89.5 - 9
10	79.5 - 8
8	59.5 - 6
7	49.5 - 5
4	19.5 - 2
3	9.5 - 1
2	5.5 - 6
1	1.5 - 2

CORE 194

SAMPLE	1	2	3	4	7	8	13	16	17	21	23	24	25	27	28	31	33	35	36	37	39	40	43	44	45	46	47	48	51	52	53	55	56	57	58	59	62	64	65	66	68	69	71	73	74	75	76	77
DEPTH FROM TOP (CM)	2-2.5	9.5-10	19.5-20	29.5-30	59.5-60	69.5-70	119.5-120	149.5-150	159.5-160	199.5-200	219.5-220	229.5-230	239.5-240	259.5-260	269.5-270	299.5-300	311-311.5	329.5-330	339.5-340	349.5-350	369.5-370	379.5-380	409.5-410	419.5-420	424-424.5	429.5-430	439.5-440	449.5-450	479.5-480	489.5-490	497-497.5	519.5-520	529.5-530	539.5-540	549.5-550	559.5-560	589.5-590	610-610.5	619.5-620	629.5-630	649.5-650	659.5-660	679.5-680	689.5-690	692.7-693.2	699.5-700	709.5-710	718-718.5
PLANKTONIC POPULATION (%)	1000	3200	2000	2600	6300	5200	8400	3200	10000	9400	7500	3800	1600	1900	4700	9100	3100	6900	6500	3400	4600	6700	10000	8500	2100	4000	2300	2200	3300	5200	19000	25000	4100	6600	7900	22000	16000	6100	9500	11000	21000	24000	1900	27000	3800	2500	4300
Globigerina bulloides	14	13	12	14	16	14	20	9	14	29	19	20	51	30	30	27	22	8	12	18	27	22	11	36	8	20	28	29	7	8	9	20	22	18	28	36	32	27	22	10	21	18	31	16	8	35	25	20
digitata		1								2		2				.7		3	1	.5	1	10	1			.4	5	4	2	.3							.4				1	1		3			4	6	4
Robertina translucens						2	1											1															2				5									2	1	
Robulus spp.															1	2				1										1				1														
Rosalina aff. columbiensis						7	2	12	6	5	11	10		1	9	1	1	1		1		3					5	1	3			25			2	26	1	1	1	3							
globularis bradyi					1	1		1	1																							3				2											
obtusa								1	3	3	2						5	2											1		2	3	1	6		1		2	3		2	2							
spp.						5	3	6	1	5	13	4		1	3		6				1								1		3	4	4	44	1	3	5	26	21	2	6	2					3	
Sigmoilina tenuis																1		2												2																	
Sphaeroidina bulloides																	1																												7			
Spirillina vivipara					1	2		2																					1								2										
Spiroloculina canaliculata							1																						1								3								3		
grata						2		7			3	1		1	1																		6			1	3	2	1	2	1			1				
Spirophthalmidium acutimargo	1							3			1							2															1	2				1	1								
Streblus beccarii & vars.																																				2	1		1								
Uvigerina auberiana																	3			1																1	2										
peregrina								1																							1	7				6							6				
Valvulineria complanata																														1	1					1	1										
Virgulina complanata																													1							1						1					
mexicana								6								3		40					9		6	1			8	3						2			2			1					
Wiesnerella auriculata						3	1	6		6	8			1		1		2														6		1	1	17	1	4	1	1								
Miscellaneous spp.	3				3	7	8	35	5	6	20	7			12	5	20	4		3	2	3	3	4		2		24	47	11	2	30	9	11	5	53	44	13	17	19		4	4	36	8			
spp. listed elsewhere							1					1	1	1		2	2													1	1	4				1	1		1				1				

TABLE 15. Distribution of Foraminifera in selected samples from Core 194.

CORE 195

SAMPLE	1	2	5	9	11	12	14	15	20	21	23	24	25	26	27	28	29	31	34	35	36	37	40	43	44	45	46	47	48	49	51	53	54	55	57	59	60	61	62	63	66	67	68	69	70	73	74	75	76	77	78	79	81	82	83	84	86	87	88	89	90	91	92	94
DEPTH FROM TOP (CM)	1-1.5	9.5-10	39.5-40	79.5-80	99.5-100	109.5-110	129.5-130	139.5-140	189.5-190	199.5-200	219.5-220	229.5-230	240-240.5	249.5-250	259.5-260	269.5-270	279.5-280	299.5-300	329.5-330	340.5-341	349.5-350	359.5-360	389.5-390	419.5-420	429.5-430	438-438.5	449.5-450	459.5-460	468.5-469	479.5-480	499.5-500	519.5-520	529.5-530	539.5-540	559.5-560	579.5-580	589.5-590	599.5-600	609.5-610	618.5-619	649.5-650	659.5-660	669.5-670	679.5-680	689.5-690	699.5-700	719.5-720	729.5-730	739.5-740	749.5-750	759.5-760	769.5-770	779.5-780	795-800	809.5-810	819.5-820	829.5-830	849.5-850	860-860.5	869.5-870	879.5-880	889.5-890	899.5-900	909.5-910	929.5-930
PLANKTONIC POPULATION (%)	2900	10000	5400	21000	8200	7800	18000	16000	4500	8800	5600	3700	2500	2400	11000	11000	5600	4600	31000	2200	2500	2200	7800	7100	6200	7800	11000	5100	9200	6300	9400	6700	8800	3100	2600	3800	14000	20000	5800	27000	12000	2800	2100	19000	8500	3300	25000	2000	5900	25000	34000	55000	53000	33000	29000	42000	18000	4300	7200	47000
Globigerina bulloides	25	6	12	8	12	18	18	14	30	38	8	17	26	43	17	14	32	22	8	13	21	25	28	16	9	17	26	28	33	23	27	9	45	26	14	63	11	16	10	1	17	25	28	29	26	16	9	33	27	37	8	23	14	5	33	23	21	13	13	43	18	40	29	30	20
digitata	.3						2							.3	3		1			2	3	.5							.4															.6	2				1		4	3	5					.6	3	2			1			2	
eggeri	8	23	10	12	15	4	7	.3	.4	1	.3	14	1	2	26	47	2		42	70	2		1	29	2	19	23	22	12	16	14	39	13	17	32	3	4	9	44	58	69	27	23	14	5	36	38	7			3	16	63	60	27	17	15	7	16	8	10	3	2	2	13
inflata	6					1	1	8	34	26	12	3	15	.3	2	9		13	4	.4	1	9		.4		16			1	2	8	15	1						9	7		.6		4	8	12	13	4		.3		13	18			12	15	20	.4	.3	21	15	24	10	8
pachyderma	7	20	10	12	11	2	3					7	.3	2	6	8			4	2				1	1	12	16	23	13	15	14	22	7	13	12		7	2	10	5		17	20	1	4	2		1				1	4	.6	28	2	1		1	4	6	1	1	19
quinqueloba		4	19	20	13	19	10	4	6	14	8	11	2	2	1	2	6	1	3	8	.4	.3	1		6	9	6	12	10	4	9	19	17	14	22	2	54	18	10	22	1	1	10	3	9	.4	3	4	3	2	.4	1	1	16	33	3	9	4		7	5	5	23	5	12	3
radians	7	1	1	1				1		.4								.3				.3	.5	1				2	3	1														.5						.6							.3			.4	1	.4			1	
Globigerinella aequilateralis					.4								8	3	5	1		4	3		2	1	5												.5										1	2			2	6	7	1			1	.3	3	4		1		2		
Globigerinita glutinata	10	13	12	11	10	15	20	2	4	1	1	1			7		2	2	4	1	1	2	1		4	5		1	1	9	12	6	15	15	5	28	11	6	8		.3	6	.3	.3	.4	2	6	1	9	8	6	.7		2	3	.6	3	8	2	5	11	9	13	1
Globigerinoides conglobata	.3																									7			.4																																						
rubra, etc.	29	23	19	22	17	1	2	26	30	30	77	24	52	39	16	14	41	60	23	1	49	57	54	35	38	1		2	5	7		.3	.3			1		27	1		.3	1	10	16	20	14	25	21	47	31	27	15	1		20	26	34	32	31	30	1	13	8	18
(typical G. rubra present)	×																		×					×					×																							×				×		×	×							
sacculifera																							4	1																											1		2	3	11	2											
tenella	6	.6	.3		4	.6		5					4	1	7	1		4	4		6	3	3	10	12	12		1	.4	1				1	1		1				.3	.3		2	5	4	6	6	10	3	1		7	1	3	10		.4		.4	3	
Globorotalia scitula		9	16	14	13	29	22	3	3	3	2	9	.6	2	5	6	3	.3	4	2	2			4	12	18	28	9	20	14	5	1	2	15	9	1	13	5	9	10		11	9	13	7	1	1	25			2			3	.6	.6	1	4	5	2	6	9	13	15
truncatulinoides	1		.3															1																			.4							5		6	6					16				9	10									
Hastigerina pelagica																		1				.6																																												
Orbulina universa					4			8		.4			5	1	1	6	.6	.3	4	2	5	3	3	4				.4			3	2			5			5		4	1	3	2	3	22	2	1	3	.7	5	5	3	.3	1	4	4	3	3	4			7	3	2
BENTHONIC POPULATION (actual numbers)	19	77	222	48	52	28	105	48	44	55	52	69	22	12	107	44	9	17	11	2	1	2	1	34	49	20	44	26	34	18	31	24	35	36	15	43	43	16	12	2	2	16	7	7	9	7	42	5	4	5	9	14	14	87	21	24	29	0	87	61	5	69	60	23
Angulogerina angulosa												1				1																						1																												
Articulina tubulosa & vars.	2	7		12	13	12	31	3	18	6	10	49		2	106		7	5			1	1						3	1						1			2	114			2	6		3	2		8	2	3	1	6			66	8	3	24		37	41	2	26	28	15
Asterigerinata mamilla	1						1		1		1	1														1		2																										1	1		1							
Astrononion stelligerum																																																												1	3									
Bolivina difformis							1								1																							2							1																					
dilitata dilitatissima						1																													1			1	3		1													2										
pseudoplicata					1	2				3		1					1	1	1	1							1	2		3			1	3			1									1				3	3			1		1	1	1		
Bulimina exilis																																					1	4																		1							
Cassidulina carinata					2					1		1		1															1					1		1																												1
crassa																	1																							6						1		2					6	3	1										
cf. oblonga							1			2				1															1									1																1	1			1						
cf. sicula									2																																																										
Cassidulinoides tenuis																																					1	23		1																										
Chilostomella mediterranensis																								1					1																1																				
Cibicides lobatulus							1		1		1	1						1								1					2		1					1										2																	1
Elphidium pulvereum								1		1			1		1																								1	1														2	2		2		1		2			
spp.							1	1		2	2																						1																						2	1		1		2			1	
Gavelinopsis praegeri, etc.					1					1								1										2									2							1																				
Globobulimina ? sp.																													2									4																								
Gyroidina delicata																																2						9																								
Miliolidae	11	26	13	8	14	4	18	2	2	5	6	1				1		4							3	13	7	15	8	13	9	15	16	26	22	8	14	7	6			1	4	3	1	1		12	1		2			4	6			6			13	11	1
Miliolinella circularis	3	18	4	15	16	3	38	29	12	20	17	2						2							11	9	4	4		2	1					1	10						1					7	1									19	9		5	1	
Neoconorbina terquemi		3	2	1	4		1	3	1		2	2	1	2													1					1				1	4					1									1						3		3	6	1
williamsoni	1					3				2	1			1				1								1		1		1		1				2	5					1														1			1			
Nonion sp. A		1	1	2				1		1				1																				1	1	2							1				1														1	
sp. B										1																		2						1							1	1														1				
Patellina corrugata																													1	1			1		1					1																							
Pullenia cf. riveroi																													1	1	1		2		1																						3	4	1	1		1
Pyrgo murrhina		8	2																		1	6																																				1	1	1	1		
Pyrgoella sphaera																												2		1	3	2				11	2																									
Quinqueloculina aff. lamarckiana		11		5																					15	13	1	8		2																															
Robertina translucens		1							1		1																																																							
Rosalina aff. columbiensis		1		1		1	4	3	2	1	10			1				1				1				2	2		2		5			2		3			1	2																					3	1	1
globularis bradyi																																1																														1		
spp.						1			2	5	1	4						1											1	1	3		1																											2				1	
Rotamorphina ? involuta																																					2																												
Spiroloculina grata									1	1																																																							
Virgulina mexicana															1	1												2		1								1																											
Wiesnerella auriculata						1	6			1		2																																																					2	3
Miscellaneous spp.	1	1		3	1		2	4	1	2		3	1							1				1	3	3	2	2	8	6	3	3		4	3	1	3	7	2	2				2	1		5		1	2		3	4	3		2	1		6	4		5	3	
spp. listed elsewhere							1					1													1												1																											
Spirophthalmidium acutimargo						1												1																																														

TABLE 16. Distribution of Foraminifera in selected samples from Core 195.

CORE 196

SAMPLE	1	2	4	7	8	13	14	17	18	22	26	31	34	36	39	40	41	42	43	44	45	47	48	49	51	52	53	55	56	58	59	60	62	64	67
DEPTH FROM TOP (CM.)	1-1.5	9.5-10	29.5-30	59.5-60	69.5-70	119.5-120	129.5-130	159.5-160	169.5-170	209.5-210	249-249.5	301-301.5	329.5-330	349.5-350	379.5-380	390.5-391	399.5-400	409.5-410	419.5-420	430-430.5	438-438.5	459.5-460	469.5-470	479.5-480	499-499.5	501.5-502	509.5-510	529.5-530	539.5-540	560.5-561	569.5-570	579.5-580	599.5-600	619.5-620	649.5-650
PLANKTONIC POPULATION (%)	80	4500	7900	7600	9600	5300	8500	5700	4800	12000	8100	11000	6000	3000	3900	17000	2500	3300	4200	260	8600	3500	7900	4900	27000	23000	5800	2900	6800	11000	6100	4700	8900	20000	230
Globigerina bulloides	13	9	10	9	10	20	9	12	29	46	22	20	20	20	8	20	20	20	15	14	37	29	23	22	26	13	37	17	12	25	28	15	29	11	13
digitata	1				.3	.3		6			1	2	2	5	1		4	2	2	1		2	1	3	.5		3	3	1	.3		.3		.3	
eggeri	23	13	18	14	25	9	7	11	1	5	20	22	13	1	55	61	2	1		43	27		6	.3	15	67	1		1	16	12	13	23	14	26
inflata	2	18		2		1	13	17	20	11	9	7	3		.4		1				1.4		10	15	13		4		8	6	2	3		5
pachyderma	8	8	13	11	12	2		2		3	6	5		1	2					3	1		1		6	1	.5	.3	13	15	3	21	12	8
quinqueloba	8	.5	9	4	14	34	5	6	36	12	5	2	2	3	3	7	.6	.5	1	1	5		3	1	6	7	3	1		8	6	25	9	43	33
radians		.7										.3									3					.6		.3				3	.4		
Globigerinella aequilateralis											1	2	6	11	5		3	2	3	10	2		3			2	1	10	.3						
Globigerinita glutinata	6	10	13	10	11	12	21	6	2	2	1	6	2	2	2	1	2	.7	2	3	.7	2	2	.3	3		.5	1	3	3	1	17	10	6	4
Globigerinoides conglobata																														1					
rubra, etc.	35	33	21	41	13	5	20	22	4	12	13	26	35	44	15	2	65	67	67	26	4	55	48	40	23	4	40	66	65	8	10	2	1		4
(typical G. rubra present)												x	x	x	x		x	x				x				x			x						
sacculifera	1																					x				x			x						
tenella		.7	1			9	.4	13	.3		3	2	10	4	1	3		4	5	.4	2	6	2	8	2	1	2	7	2	1	.3	1	.4		
Globorotalia scitula	2		15	9	14	7	24	1	7	9	3	2	3	2	5	3	1			1	5		2	3	5	2	2			16	21	18	1	12	7
truncatulinoides	1	5									15	1											1												
Hastigerina pelagica												.3	.3						.4			.5					.3	.6						
Orbulina universa		2						4			.4	2	3	7	2	2	4	1	2	3	4	.5	1	4		4	4	1	4				2	1	
BENTHONIC POPULATION (actual numbers)	0	18	66	108	44	42	26	14	28	58	58	30	10	7	0	1	2	5	0	1	1	4	59	22	132	1	2	1	1	19	16	149	51	17	0
Articulina tubulosa & vars.		4	85	65	12	12	4		4	32	53	13	6	4									1	51	13	114		1		5			1	4	
Bolivina catanensis																																			
difformis						1					1	1												1	2				1			4			
dilitatus dilitatissimus																							1		2						1	3			
pseudoplicata						1			1	2										1					1							8			
Bulimina costata																							1						3			10	1		
exilis																																3			
marginata																																4			
Cassidulina carinata																																3			
crassa				1								1			1																	11			
cf. sicula																								4								1	1		
Cassidulinoides tenuis										1																						2			
Chilostomella mediterranensis													1																			2			
Cibicides lobatulus												1				1																3			
Elphidium crispum				1																							1					2	2		
cf. minimum																																2	1	1	
spp.				2		1					1																					2		1	
Gavelinopsis praegeri, etc.																																2		1	
Loxostomum alatum																																5			
Miliolidae		3	2	2	3	6	2	1	3	2																						2			
Miliolinella circularis		8	7	29	18	11	12	11	9	3		2											1	2	1					4	6	25	22		
Neoconorbina terquemi			1		1				1				1	1										1						1	3	8	7		
williamsoni			1		1	3		1	2			1																							
Nonion sp. A				1					2	2																				1	4	1			
sp. B				1									1				1						2							2	1	1	1	3		
Patellina corrugata					1					1																					1	2			
Robertina translucens					1				2	2																						3		2	
Rosalina aff. columbiensis				1	2	2			4		1	1					1				1		1												
obtusa			1						2																2					1	1	1	1		
spp.		2		1	2	3										1																6			
Spirillina vivipara			1																													1			
Spiroloculina grata							3		1									1				1													
Wiesnerella auriculata					1	2		2	2				1									1										1	3		
Miscellaneous spp	1	5	1	2	1	2	1	1	4	2	8		1								1	1		6	1				3	2	22	9	3	
spp listed elsewhere			2	1					2			1								1			1	2	1						6		1	
Virgulina mexicana			1							1																									

TABLE 17. Distribution of Foraminifera in selected samples from Core 196.

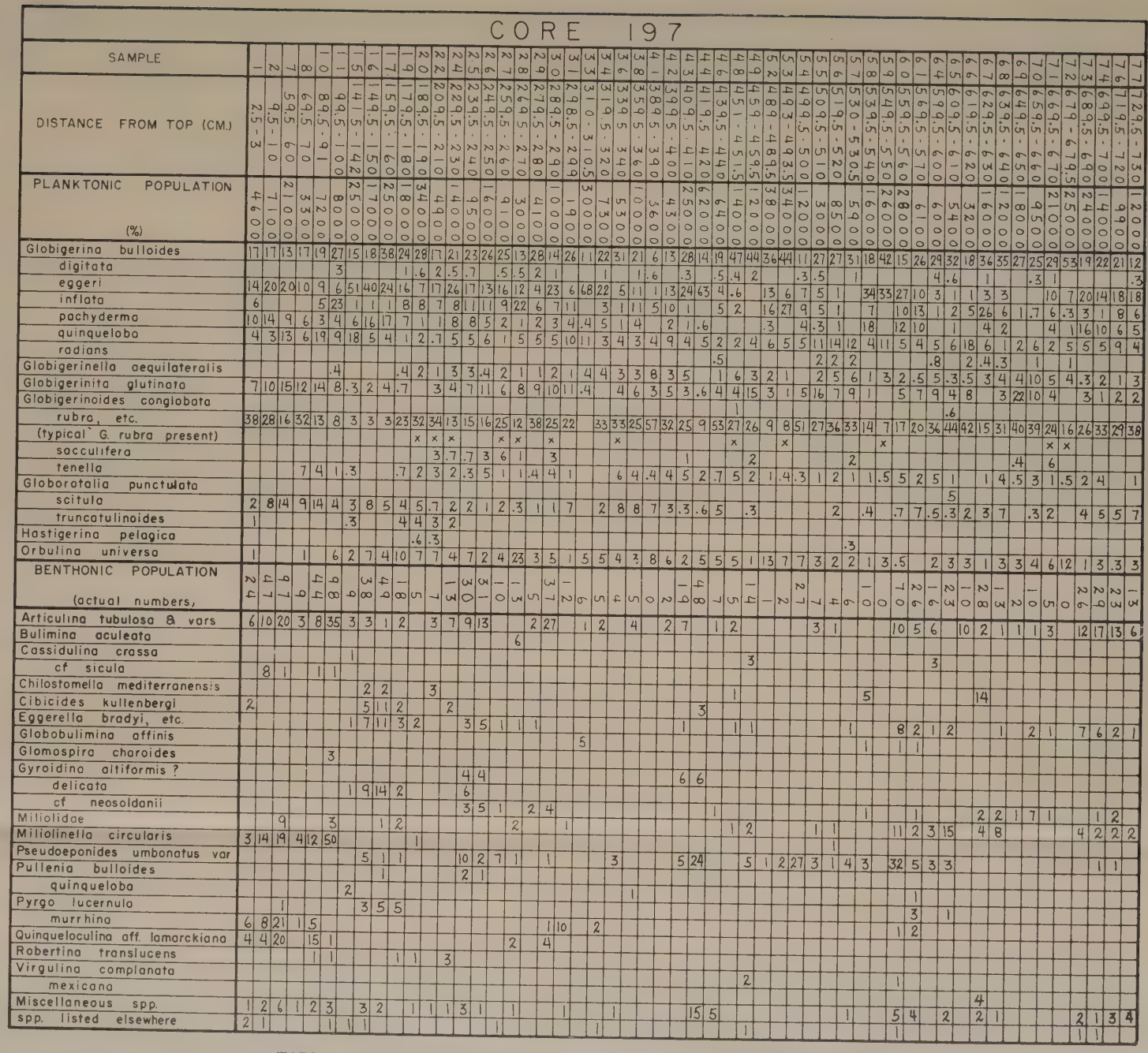


TABLE 18. Distribution of Foraminifera in selected samples from Core 197.

CORE 198

SAMPLE	1	2	3	4	5	6	7	11	12	18	23	25	26	28	29	33	36	39	41	43	44	46	52	54	58	60	61	62	65	66	69	72	73	74	77	79	82	84	86	89	90	93	94	96	97	98	99	100	101	102	103	104	105	106	107	109	110	111	114	115	118
DEPTH FROM TOP (CM.)	1-1.5	9.5-10	19.5-20	29.5-30	39.5-40	49.5-50	59.5-60	97.5-98	109.5-110	169.5-170	219.5-220	239.5-240	249.5-250	269.5-270	279.5-280	319.5-320	349.5-350	379.5-380	399.5-400	419.5-420	429-429.5	449.5-450	508.5-509	529.5-530	570.5-571	589.5-590	599.5-600	609.5-610	629.5-630	639.5-640	669.5-670	699.5-700	709.5-710	719.5-720	749.5-750	769.5-770	799.5-800	819.5-820	839.5-840	869.5-870	879.5-880	899.5-900	909.5-910	929.5-930	939.5-940	949.5-950	959.5-960	969.5-970	978.5-979	989-989.5	999.5-1000	1009.5-1010	1019.5-1020	1029.5-1030	1039.5-1040	1061-1061.5	1069.5-1070	1079.5-1080	1109.5-1110	1119.5-1120	1148.5-1149
PLANKTONIC POPULATION (%)	460	2000	1900	2100	2100	40	2600	890	3800	5200	8800	1100	8400	6000	1400	3700	1200	3200	1400	2800	1700	9000	4900	4100	1200	5000	15000	4100	1400	860	3500	2400	6400	3000	5100	4900	7700	4300	1900	2100	4700	24000	22000	17000	2700	3700	7600	2100	12000	2200	7100	34000	5700	3000	4700	2100	5000	2600	970
Globigerina bulloides	12	23	13	8	12	30	20	9	16	11	33	20	44	9	4	23	6	40	60	23	42	26	34	27	30	26	25	25	20	19	28	32	40	47	45	36	11	45	21	9	10	45	49	11	23	34	18	25	17	39	16	24	31	25	9	28	30	31	56	45
digitata															2		2												6	8	1	.7									.4				.4					1			.3		.3							
eggeri	8	22	13	7	10	9	11	11	20	26	19	15	7	13	8	26	7	6	7	3	3	24	18	7	5	15	47	23	2	.7	21	27	28	17	29	29	39	27	5	51	67	30	28	6	4	3	14	9	16	2	9	60	21	7		12	2	13	3	5
inflata	15	10	13	21	20			6	15	57	11	46	13	.3	15	1	15	.3	17	3	2	21	15	8			7	.5	10	3			13	7						19	27	29	22	26	.5	1	19		8	20	2		31	18	14	26
pachyderma	1	17	7	3	11	23	11	4	9	8	3	2	.4	2		5	2	.7		1	.4	3			1	.3					2	2	8	4	12	3	11	11	1	6			9	2	.6					.4			13	1		10	1	16	3	2
quinqueloba	1	2	2	.4	.6			19		.6	7	4	17	8	1	6	9	10	6	2	1	1		1	.3	.3	1	3	1		8	7	4	2	.5	8	9	1	2	8	12	23	.6	1	.7	.4	1		.3	2		11	2		1	5	6	5	2	1
radians																																			2	.6														.4												
Globigerinella aequilateralis	.4	.6		.6																3	.5	.6		10	3		.4		1	7	2														.7		3			1			.3	6					
Globigerinita glutinata	10	3	10	2			6	22	5	7	11	9	6	7	5	7	1			.3	.5		.4	.3	6	3	.4	.3	.5	1	2	.5	4	3	11	7	7	3	7			3			3		5		.7	3	3	2	5	3	12	2	.3	7
Globigerinoides conglobata																				6							4	1	1	.5	.3	6																														
rubra, etc	49	21	29	42	43	27	36	2	38	35	14	30	.4	22	1	17	23	26	26	44	41	20	38	44	41	31		22	51	73	61	16	3		1	.6				32	2			1	40	28	1	25	34	32	33	28	1	10	30	59	38	2		12	5
(typical G. rubra present)	x	x		x																			x			x					x	x													x	x		x							x					
sacculifera	.6		.4																											8	2	1																	.4	1										
tenella							.3																			6					1	1	2	16											3	2		1	3	8	4	.7		3		3					
Globorotalia scitula			2		2	11	15	33	12	12	13	14	19	24	3	4	4	4	.6	4	3	.5	1	3	2	3		3	4			7	5	18	13	2	13	11	9	6	10	10		6	11	1	6	.4			6		5	1		4	13	12	5	8
truncatulinoides	3	.6	10	14	.6																	9			1															.3					8	.4	8		18	1	21			10	10					
Hastigerina pelagica																														1																														
Orbulina universa				2								5			18						1	5	1	8		6	7	3	4	6	6	8	3			4		12		14		2	3	6	5	25	4	2	3	9	3	.6	4	3	4		3	3	4	1
BENTHONIC POPULATION (actual numbers)	11	19	21	10	24	0	8	22	23	32	20	14	2	25	28	31	25	10	7	5	0	27	0	18	0	0	0	0	0	0	0	14	19	0	1	5	6	13	5	4	127	53	0	4	4	0	18	2	0	0	0	0	45	12	0	27	20	38	27	2
Articulina tubulosa & vars	1	6	7	4	6			3	4	6	3	3	1	14	8	11	6	1	2	4		27		18								1				1	1	3	3	3	123			4	1		8	2					43	11		18	13	9	27	2
Bolivina catanensis	1							1																																	1																					
dilitata dilitatissima																																									3																				
Bulimina exilis																																									8																				
Cassidulinoides tenuis								2																																1	8																				
Chilostomella mediterranensis																																									7																				
Globobulimina ? sp																																									8																				
Gyroidina delicata																																								2	2																				
Miliolidae	1	2	3	1	1		3	2	6	7	6	3	1	1																	10	4			4	3	8		1	1			2					1			2								
Miliolinella circularis	4	10	9	5	16		5	2	11	18	9	8		9	19	20	17	8	5	1											1				1	1																								
Neoconorbina williamsoni	2																																																													
Pyrgo murrhina								1	2																							8																													
Pyrgoella sphaera																															1							2																					
Quinqueloculina aff lamarckiana											2																																																			
Robertina translucens																	1	1																												3																
Virgulina mexicana																																									2																				
Miscellaneous spp	1	1	2		1			7		1					1		1														2	6				1	1		1		6			1		7					1			2	1	2			
spp listed elsewhere	1							4						1																											7																1	1			

TABLE 19. Distribution of Foraminifera in selected samples from Core 198.

CORE 199																																													
SAMPLE	1	2	6	10	11	12	14	16	19	23	28	30	33	35	36	41	43	45	50	51	53	54	56	57	59	60	62	63	66	67	68	69	73	74	75	76	77	78	79	80	81	83	85	86	91	94
DEPTH FROM TOP (CM)	0 - 0.5	9.5 - 10	45.5 46	81.5 82	92.5 - 93	103.5 104	123.5 124	139.5 - 140	169.5 - 170	205.5 - 206	255.5 - 256	276.5 - 277	301.5 - 302	310.5 - 311	317.5 - 318	362.5 - 363	383.5 - 384	403.5 - 404	442.5 - 443	452.5 - 453	469.5 - 470	473.5 - 474	492.5 - 493	499.5 - 500	519.5 - 520	529.5 - 530	549.5 - 550	559.5 - 560	589 - 589.5	599.5 - 600	609.5 - 610	619.5 - 620	656.5 - 657	666.5 - 667	676.5 - 677	686.5 - 687	696.5 - 697	704.5 - 705	713.5 - 714	723.5 - 724	731.5 - 732	749.5 - 750	767.5 - 768	779.5 - 780	827.5 - 828	846.5 - 847
PLANKTONIC POPULATION	2400	1900	1800	1400	1500	2600	1600	2500	1200	2300	290	1300	3200	2500	500	830	430	1100	1100	1100	270	490	2900	1800	420	520	580	1700	520	1600	1500	3100	1600	470	1200	2900	1100	1200	890	1800	1500	1200	1100	960	800	410
(%)																																														
Globigerina bulloides	23	21	20	28	29	32	13	18	24	36	24	60	34	40	47	38	5	44	43	24	36	27	25	17	31	38	33	29	45	33	41	32	54	35	26	43	29	28	26	14	39	20	11	11	10	24
digitata	1								.3					1	1		.5			.4		3	.3		2	2	1					.4		.6	2	.6			6				1		2	3
eggeri	11	15	15	11	12	8	19	16	18	6	14	8	9	13	20	9	3	15	6	14	19	21	34	35	6	.4	9	25	12	18	5	14	2	4	4	12	9	2	2	18	4	10	11	4	4	6
inflata	6		2	4	5	1	6	4	6	11	12	15	13	12	3	1	3	7	2	7	7	17	14	11	10				10	1	14	10	13	27	22	11	8	19	4	22	23	26	13	24	29	24
pachyderma	2	6	1	3	1	.5	2	4		2	5	.6	1	5	8				1	1	6	3	4	1	4			11	10	15	2	13	1		.5	6	3	3		25	4	5	26	4	.5	2
quinqueloba	8	19	35	22	18	21	34	21	10	29	28	13	20	14	11	41	45	20	4	4	18	3	5	5	4	2	2	17	2	9	14	11	14	1	9	5	5	9	2	2	4	3	8	6	8	.7
radians																											.5								.3	.3										
Globigerinella aequilateralis																			3	3		.6		1	1	2	2										1	.3	4	1			1	3	2	1
Globigerinita glutinata	3	15	13	13	13	23	9	17	19	5	3			.3	.4		2	.7	.4			1			4	.6	2	6	1		7	5	1		5	9	7	11	11	3	2	.3		1	3	.7
Globigerinoides conglobata																												2	9									1	3				.4			
rubra, etc	33	11		4	4	3	.5	6	5	4	7	2	16	10	6	9	41	11	36	43	9	19	10	17	33	47	45	1	.4	.4			2	22	13	.3	23	9	22	7	14	13	18	31	27	27
(typical G rubra present)																									x	x	x																	x	x	
sacculifera	8																					.4				1																		1		
tenella	1	1					.3		1	.4	.3	.3				.5		.4		1			2	5	2	2	2	3	2						1		.5	2	2	2	2	1	.4	6	4	3
Globorotalia scitula	1	12	13	15	18	12	16	14	13	6	6	1	7	5	4	1	.7	2	1	1	4	2	1	2	1		.5	5	8	23	14	12	10	7	15	11	13	12	7	4	4	9	10	5	3	.5
truncatulinoides	1																			.4		.4	3																6			9		2	5	7
Orbulina universa	2								4	.4	.7			.6					3	1		2	1	5	2	5	2				3	2	2	3	2	2	2	3	5	1	3	3		2	2	1
BENTHONIC POPULATION (actual numbers)	64	10	68	33	30	40	54	36	15	64	17	45	27	26	10	30	15	32	24	7	5	33	25	20	10	1	7	14	12	42	28	58	23	2	7	26	3	1	5	4	6	2	10	7	1	4
Articulina tubulosa & vars	2	1	15	1		1			2	3	1	4	5	3		18	4	14	1	4			9	8			1			5	6	20	16		3	2			1							
Bolivina albatrossi																				1		2	1		2				1																	
catanensis	1									1	1				1											1				2																
dilitata dilitatissima										1				1				1												2		2														
pseudoplicata																		1	4			1			1															2	3	2	4			1
Bulimina costata	1	1	4		1		2	3		1	1	13		2		1	2	1										4	2	1	1	1			1		1									
gibba	2																					1																								
Cassidulina carinata	1																1	2												2																
crassa										1													2				1																			
cf. sicula	1	2	9	3	11	15	30	2		30	7	6	13	7	4	1	3			1	1		1	9																						
Chilostomella mediterranensis		1														1						1	2					1																	1	
Cibicides aff. floridanus	11	1	2	2	1	1	7		1	6	2	8			2			2																												
kullenbergi	3																																		1	16			1							
Eggerella bradyi, etc.	1																													1				1		1		1								
Elphidium crispum	2																					2																								
pulvereum										1	2			1								2																								
Globobulimina affinis	1	1						9	1													1	4	3																						
pseudospinescens								3		6		3	1																																	
Gyroidina altiformis	1																	1												1																
cf. neosoldanii	4																	1	3		2	2	3		4		2	1															2	1		3
Hoglundina elegans	2																	1	1	1																										
Hyalinea balthica	1										1			1		1						1																								
Miliolidae	1		1	1	1				1			2		2		1					1	1			1				2	17	10	7	1				1		1		1		3	3		
Miliolinella circularis			1											2		3	2	1	5																				1				1	1		
Neoconorbina williamsoni									1		1					1																														
Nonion barleeanum, etc.	2								1	1				1					1																											
Pseudoeponides umbonatus var.																												2	3			1														
Pullenia bulloides														1		1																								1						
quinqueloba										1		1		1					1									1																		
cf. riveroi													2	2															1	3	5	3	4			4										
Pyrgo anomala						1																1							1	1																
murrhina	1		21	11	3	18	9	15		4		5	1															1			5	19														
Quinqueloculina aff. lamarckiana		3	7	9	11	3	4			1																			1																	
Robertina translucens									1									2	2													1														
Robulus spp.														1	1			2												1									1							
Rosalina aff. columbiensis	1																		2			1																								
Siphonina reticulata	4																																													
Spiroloculina canaliculata									1	1		1			1			1	1																											
Uvigerina mediterranea	3																					4																								
peregrina	3			1																										1																
Miscellaneous spp.	8		8	4	2	1	1	4	3	4		2	3		1	2	3	2	1		1	8	2		2			4	1	4	1	3	2	1	2	3					2			2		
spp. listed elsewhere	7			1			1		3	2	1			1					2			5	1				3			1		1					1			1						

TABLE 20. Distribution of Foraminifera in selected sample from Core 199.

PLATES

PLATE 1

Figure		Page
1, 2.	*Involutina* cf. *I. planorbis* (Höglund). X 32. ATLANTIS Sta. 4694	253
3, 4.	*Textularia calva* Lalicker. X 32. ATLANTIS Sta. 4654 B	254
5, 6.	*Textularia conica* d'Orbigny. X 45. ATLANTIS Sta. 4654 B	254
7.	*Pseudoclavulina crustata* Cushman. X 32. ATLANTIS Sta. 4694	254
8.	*Eggerella bradyi* (Cushman). X 45. Core 189, sample 49	254
9.	*Karreriella bradyi* (Cushman). X 45. Core 189, sample 49	254
10, 11.	*Biloculinella labiata* (Schlumberger). X 45. ATLANTIS Sta. 4694	255
12, 13.	*Articulina tubulosa* (Seguenza) variants. X 57. Core 184, sample 48	255
14.	*Pyrgoella sphaera* (d'Orbigny). X 32. ATLANTIS Sta. 4654 B	256
15.	*Pyrgo lucernula* (Schwager). X 27. Core 187, sample 74	256
16, 17.	*Miliolinella circularis* (Bornemann). X 45. Core 196, sample 4	255
18, 19.	*Articulina tubulosa* (Seguenza). X 57. (18) Core 189, sample 62; (19) Core 199, sample 6	255
20, 21.	*Quinqueloculina* aff. *Q. lamarckiana* d'Orbigny. (20) X 32. ATLANTIS Sta. 4657; (21) X 27. Core 188, sample 10	256
22, 23.	*Pyrgo anomala* (Schlumberger). X 32. ATLANTIS Sta. 4668	255
24.	*Sigmoilina tenuis* (Czjzek). X 45. ATLANTIS Sta. B. S. 9 (Cruise 151)	257
25.	*Sigmoilina distorta* Phleger and Parker. X 45. ATLANTIS Sta. 4658	256
26, 27, 28.	*Spiroloculina canaliculata* d'Orbigny. X 45. ATLANTIS Sta. B. S. 20 (Cruise 151)	257
29, 30.	*Spiroloculina angulosa* Terquem. X 32. ATLANTIS Sta. B. S. 20 (Cruise 151)	257
31.	*Spiroloculina grata* Terquem. X 45. ATLANTIS Sta. 4658	257
32, 33.	*Lagenonodosaria scalaris* (Batsch). X 45. (32) ATLANTIS Sta. B. S. 61 (Cruise 151); (33) ATLANTIS Sta. B. S. 20 (Cruise 151)	258
34, 35.	*Astrononion stelligerum* (d'Orbigny). X 45. ATLANTIS Sta. 4668	258
36, 37.	*Nonion barleeanum* (Williamson). X 45. ATLANTIS Sta. 4664	258
38, 39.	*Nonion formosum* (Seguenza). X 45. ATLANTIS Sta. 4664	258
40, 41.	*Nonion* sp. B. X 57. ATLANTIS Sta. 4665	259
42, 43.	*Nonion* sp. A. X 57. (42) Core 196, sample 64; (43) Core 196, sample 59	258

PLATE 2

Figure		Page
1, 2.	*Angulogerina angulosa* (Williamson). X 45. ATLANTIS Sta. 4723	259
3, 4.	*Bolivina albatrossi* Cushman. X 57. ATLANTIS Sta. 4691	259
5, 6, 7.	*Bolivina dilitata dilitatissima* Silvestri. X 45. (5, 6) ATLANTIS Sta. 4664; (7) Core 188, sample 73	260
8.	*Bolivina pseudoplicata* Heron-Allen and Earland. X 57. ATLANTIS Sta. 4654 B	261
9.	*Bolivina difformis* (Williamson). X 75. ATLANTIS Sta. 4654 B	260
10, 11.	*Bolivina catanensis* (Seguenza). X 45. ATLANTIS Sta. 4666	260
12, 13, 14.	*Bolivina attica* Parker, n. sp. X 57. (12) Holotype (U. S. N. M. P 6123); (13, 14) Paratypes (U. S. N. M. P 6124 a, b). ATLANTIS Sta. B. S. 20 (Cruise 151)	259
15, 16.	*Bolivina subaenariensis* Cushman. X 45. Core 184, sample 46	261
17, 18.	*Bulimina aculeata* d'Orbigny. X 45. Core 189, sample 85	261
19, 20.	*Bulimina costata* d'Orbigny. X 45. Core 184, sample 29	261
21, 22.	*Bulimina gibba* Fornasini. X 45. ATLANTIS Sta. 4667	261
23.	*Bulimina marginata* d'Orbigny. X 45. ATLANTIS Sta. 4694	262
24, 25.	*Globobulimina affinis* (d'Orbigny). X 34. Core 184, sample 28	262
26, 27.	*Globobulimina pseudospinescens* (Emiliani). X 45. (26) Core 184, sample 42; (27) Core 184, sample 23	262
28.	*Globobulimina* ? sp. X 45. Core 189, sample 47	262
29.	*Bulimina exilis* Brady. X 45. Core 186, sample 70	261
30, 31, 32.	*Loxostomum alatum* (Seguenza). X 45. ATLANTIS Sta. B. S. 20 (Cruise 151)	262
33.	*Reussella spinosissima* (Costa). X 45. ATLANTIS Sta. 4662 A	263
34.	*Robertina translucens* Cushman and Parker. X 45. ATLANTIS Sta. B. S. 61 (Cruise 151)	263
35, 36.	*Uvigerina auberiana* d'Orbigny. X 45. ATLANTIS Sta. 4713	263
37, 38.	*Uvigerina peregrina* Cushman. X 45. ATLANTIS Sta. 4691	263
39, 40.	*Uvigerina mediterranea* Hofker. X 45. (39) ATLANTIS Sta. 4691; (40) ATLANTIS Sta. 4721 A	263

PLATE 3

Figure		Page
1, 2, 3.	*Spirillina wrightii* Heron-Allen and Earland. X 45. ATLANTIS Sta. 4654 B	264
4.	*Spirillina vivipara* Ehrenberg. X 45. ATLANTIS Sta. 4668	264
5, 6.	*Asterigerinata mamilla* (Williamson). X 45. ATLANTIS Sta. 4654 B	264
7, 8, 9.	*Gyroidina delicata* Parker, n. sp. X 45. (7) Holotype (U. S. N. M. P 6340); (8, 9) Paratypes (U. S. N. M. P 6341 a, b). Core 195, sample 57	265
10, 11, 12.	*Gyroidina altiformis* R. E. and K. C. Stewart. X 45. ATLANTIS Sta. B. S. 20 (Cruise 151)	265
13, 14, 15, 16, 17, 18.	*Gyroidina* cf. *G. neosoldanii* Brotzen. X 45. (13, 14, 15) ATLANTIS Sta. B. S. 21 (Cruise 151); (16, 17, 18) ATLANTIS Sta. 4713	265
19, 20.	*Gyroidina umbonata* Silvestri. X 57. ATLANTIS Sta. B. S. 21 (Cruise 151)	266
21, 22, 23.	*Hanzawaia rhodiensis* (Terquem). X 45. (21) ATLANTIS Sta. B. S. 20 (Cruise 151); (22, 23) ATLANTIS Sta. 4667	267
24, 25.	*Gavelinopsis praegeri* (Heron-Allen and Earland). X 45. Core 186, sample 73	264
26, 27.	*Neoconorbina terquemi* (Rzehak). X 45. ATLANTIS Sta. 4668	267
28, 29.	*Neoconorbina williamsoni* (Parr). (28) X 45. Core 191, sample 36; (29) X 75. Core 191, sample 14	267
30, 31, 32.	*Pseudoeponides umbonatus* (Reuss) variant. X 45. Core 189, sample 86	267
33, 34, 39.	*Rosalina obtusa* d'Orbigny. X 45. ATLANTIS Sta. 4654 A	268
35, 36.	*Rosalina* aff. *R. columbiensis* (Cushman). X 57. Core 192, sample 6	267
37, 38.	*Rosalina globularis bradyi* (Cushman). X 45. ATLANTIS Sta. 4668	268
40, 41.	*Rosalina suezensis* (Said). X 57. ATLANTIS Sta. B. S. 20 (Cruise 151)	268
42, 43, 44.	*Valvulineria complanata* (d'Orbigny). X 45. ATLANTIS Sta. B. S. 20 (Cruise 151)	268

PLATE 4

Figure		Page
1, 2.	*Rotalia granulata* (di Napoli Alliata). X 45. ATLANTIS Sta. 4662 A ..	269
3, 4.	*Elphidium advena* (Cushman). X 45. ATLANTIS Sta. 4668	269
5.	*Elphidium complanatum* (d'Orbigny). X 45. ATLANTIS Sta. 4668 ..	270
6.	*Elphidium pulvereum* Todd. X 45. Core 199, sample 32	271
7.	*Parrellina verriculata* (Brady). X 45. ATLANTIS Sta. 4668	271
8, 9.	*Elphidium* cf. *E. minimum* (Seguenza). X 45. ATLANTIS Sta. 4662 A	271
10, 11.	*Elphidium granosum* (d'Orbigny). X 45. ATLANTIS Sta. 4662 A ...	270
12.	*Cassidulina crassa* d'Orbigny. X 57. ATLANTIS Sta. 4654 B	271
13.	*Cassidulina subglobosa* Brady. X 57. ATLANTIS Sta. 4723	272
14.	*Cassidulina* cf. *C. oblonga* Reuss. X 45. ATLANTIS Sta. 4654 B ...	272
15.	*Cassidulina carinata* Silvestri. X 45. ATLANTIS Sta. 4667	271
16, 17.	*Cassidulina* cf. *C. sicula* Seguenza. X 75. (16) Core 199, sample 27; (17) Core 199, sample 2	272
18, 19.	*Cassidulinoides tenuis* Phleger and Parker. X 45. Core 189, sample 47	272
20.	*Virgulina complanata* Egger. X 57. Core 189, sample 85	272
21, 22, 23.	*Epistominella rugosa convexa* Parker, n. subsp. X 57. (21) Holotype (U. S. N. M. P 6125); (22, 23) Paratypes (U. S. N. M. P 6126 a, b), ATLANTIS Sta. 4723	273
24.	*Chilostomella mediterranensis* Cushman and Todd. X 34. ATLANTIS Sta. 4660	273
25.	*Siphonina reticulata* (Czjzek). X 45. ATLANTIS Sta. 4713	273
26, 27.	*Virgulina mexicana* Cushman. X 45. ATLANTIS Sta. 4676	272
28, 29, 30.	*Rotamorphina ? involuta* Parker, n. sp. X 57. (28) Holotype (U. S. N. M. P 6127); (29, 30) Paratypes (U. S. N. M. P 6128 a, b). ATLANTIS Sta. 4714	274
31.	*Pullenia* cf. *P. riveroi* Bermudez. X 45. Core 190, sample 78	273
32, 33.	*Pullenia quinquelobu* (Reuss). X 45. ATLANTIS Sta. 4654 B	273
34, 35, 40.	*Cibicides kullenbergi* Parker. X 45. Core 189, sample 49	275
36, 37, 38.	*Cibicides* aff. *C. floridanus* (Cushman). X 34. Core 199, sample 30 ...	274
39.	*Hyalinea balthica* (Schroeter). X 45. Core 184, sample 58	275
41, 42.	*Cibicides wuellerstorfi* (Schwager). X 32. (41) Core 184, sample 58; (42) Core 184, sample 55	275
43.	*Planulina ariminensis* d'Orbigny. X 27. Core 184, sample 46	276
44.	*Planorbulina mediterranensis* d'Orbigny. X 28. ATLANTIS Sta. B. S. 61 (Cruise 151)	276

PLATE 5

Figure | Page

1, 2, 3, 4. *Globigerina bulloides* d'Orbigny. (1) X 24. Core 197, sample 44; (2, 3) X 24. ATLANTIS Sta. 4711; (4) X 38. Core 199, sample 1 276

5, 7. *Globigerina eggeri* Rhumbler. X 30. (5) Core 189, sample 40; (6) Core 189, sample 47 277

6. *Globigerina* sp. X 44. Core 193, sample 34 276

8. *Globigerina digitata* Brady. X 24. Core 193, sample 26 276

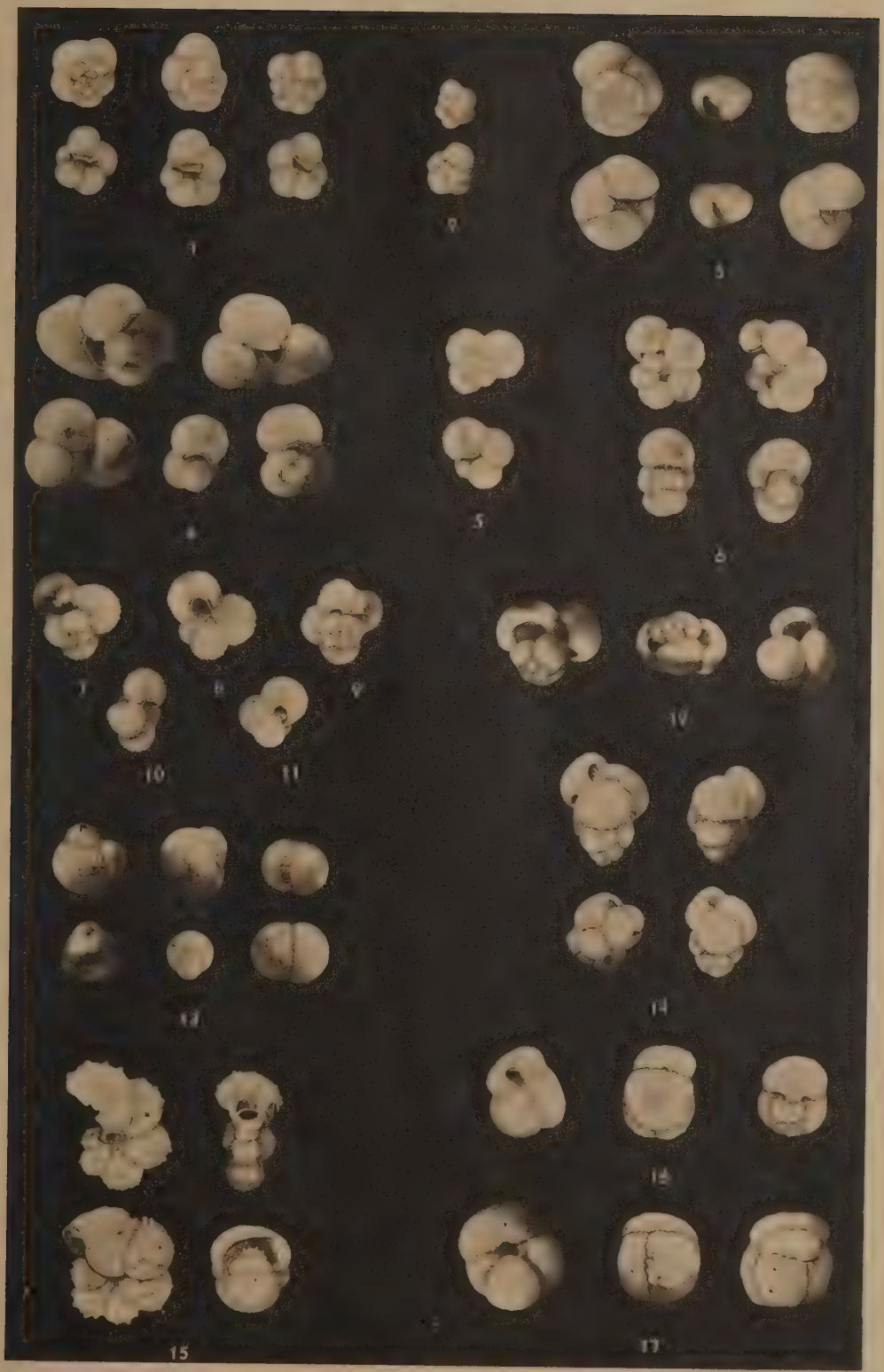
9. *Globigerina pachyderma* (Ehrenberg). X 30. Core 198, sample 2 278

10. *Globigerina radians* Egger. X 44. Core 187, sample 71 278

1
2
3
4
5
6
7
8
9
10

PLATE 6

Figure		Page
1.	*Globigerina quinqueloba* Natland. X 44. Core 199, sample 2	278
2.	*?Globigerina quinqueloba*. X 44. Core 199, sample 66	278
3.	*Globigerina inflata* d'Orbigny. X 30. Core 199, sample I	277
4.	*Globigerinoides sacculifera* (Brady). X 24. ATLANTIS Sta. 4711	280
5, 6.	*Globigerinella aequilateralis* (Brady). (5) X 44. Juvenile specimens; (6) X 24. Adult specimens. ATLANTIS Sta. 4711	278
7, 8, 9, 10, 11.	*Globigerinoides tenella* Parker, n. sp. X 45. (7) Holotype (U. S. N. M. P 6129); (8, 9, 10, 11) Paratypes (U. S. N. M. P 6130 a—d). ATLANTIS Sta. 4711	280
12.	*Globigerinoides rubra* (d'Orbigny). X 24. Core 189, sample 37	279
13.	*Orbulina universa* d'Orbigny. X 24. Aberrant specimens. ATLANTIS Sta. 4711	280
14.	*»Globigerinoides pyramidalis»* vanden Broeck. X 24. Core 197, sample 44	279
15.	*Hastigerina pelagica* d'Orbigny. X 24. ATLANTIS Sta. 4711	280
16.	*?Globigerinoides conglobata* (Brady). X 38. Core 189, sample 29	279
17.	*Globigerinoides conglobata* (Brady). X 24. Core 198, sample 43	279



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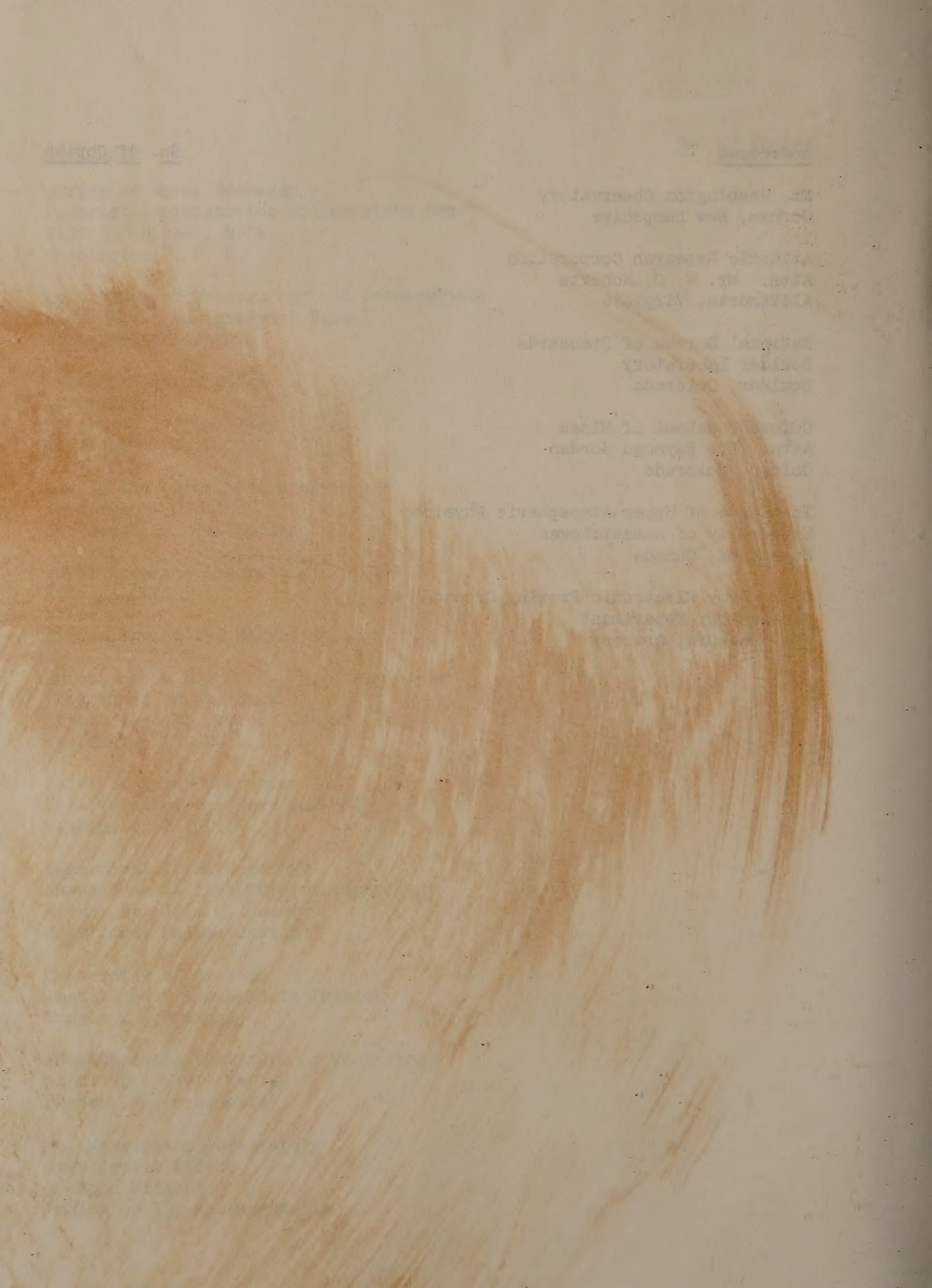
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